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USING A CANAL BED AS DRIVEWAY FOR BRINGING UP MATERIAL—[See page 313]

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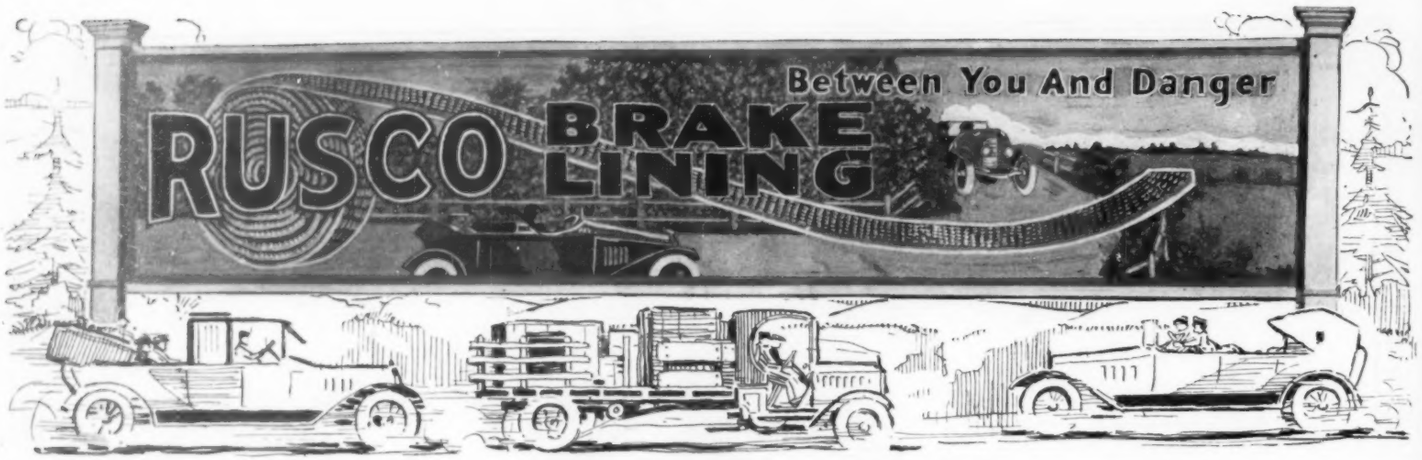

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The Revival of the American Monitor

AN unexpected naval development was the reappearance, during the war, of the Monitor type of our Civil War days. Of course, in the 50 years or more that intervened between the two great struggles, there had been a great development in the principles and practice of naval architecture, all of which was available to the British naval constructors when they adopted the principle of the monitor and applied it to modern conditions. Consequently, in the British monitors, one of the largest and most powerful of which is shown in the above engraving, we notice a great increase in size, free-board, seakeeping qualities and offensive power.

Strictly speaking it is stretching the point somewhat to call the 6,650-ton "Marshal Ney" a monitor, inasmuch as she lacks the essential quality of low free-board. In this respect the Italian monitor, "Fra di Bruno," which is described as a great armored raft for carrying heavy guns, is more strictly in the Monitor class.

Monitors of the past war were built for seacoast work, and this was done in the North Sea mainly against the German batteries on the Belgian coast, and in the various operations against the Turks at the Dardanelles. In the case of the Italian navy they were used for coastal work in the Adriatic. The British built 16 sea-going monitors and 18 river monitors. The sea-going monitors ran, in size, from 1,260 tons to 8,000 tons and the river monitors had about 575 tons displacement. The armor protection, in the case of the sea-going monitors, consisted of belts of from 2″ to 6″, associated with 2″ protective decks and 4″ bulk-heads, while the gun positions carried armor of from 10.8″ to 13.8″.

The armament consisted, in the main battery of two guns, varying from 12″ to 15″ in caliber, and carried always in a single 2-gun turret. The speed in the majority of these vessels was 6.5 knots, but in the 1,260-ton "Merseys" and in the 8,000-ton "Erubus" and "Terror" the speed was 12 knots. The earlier river monitors mounted one 9.5″ gun and the others tko 6-inch. Their speed was 12 and 10 knots.

For the purposes for which they were used on the Belgian and Dardanelles coasts, a valuable feature of these monitors was their light draft, which was only 5′8″ in the "Mersey" class of 1,260-tons and 10′ in the "Marshal Ney" and other monitors of from 6,000 to 6,700 tons. This enabled the vessels to operate in the shoal waters which lie off the Belgian coast and in certain parts of the Adriatic.

The Italian monitor "Fra di Bruno" was one of five ships, the others being the "Carso," "Cucco," "Monfalcone" and the "Vodice." They were built, as we said, of raft-like form, and their low free-board and limited draft rendered them suited for work in the shoal waters at the mouth of the Piave River. They operated here in excellent concealment, and their powerful long-range 15″ guns were of great assistance in checking the Austrian advance after the break through at Caporetto.

The monitor has always been considered as a strictly defensive vessel for operation along one's own coast-line and for coöperation with the forts in the protection of harbors and roadsteads. It is among the many surprises of the war that they should have been used in very strenuous offensive operations, in some cases at a great distance from their home ports. This, of course, was rendered possible only by the fact that Great Britain, and the Allies in general, had the command of the sea.

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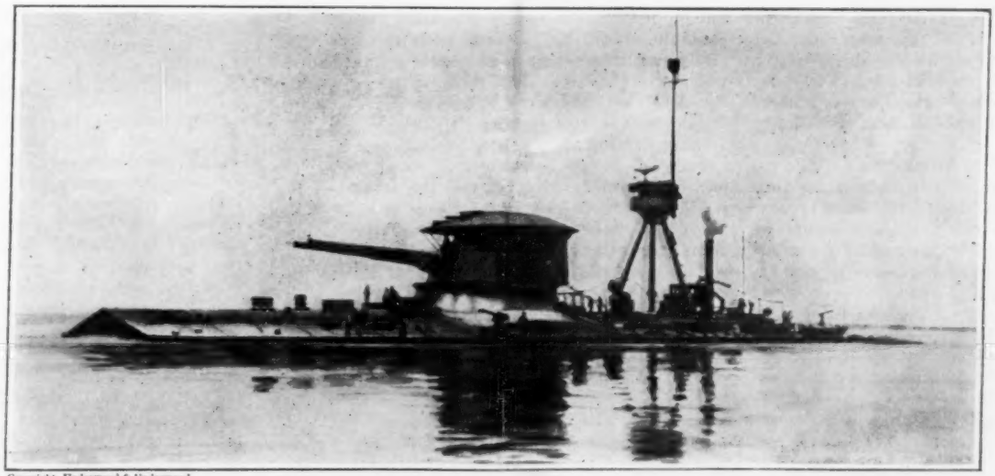
Monitor "Marshal Ney." Displacement, 6,670 tons. Speed, 6.5 knots. Armor: belt, 4″; deck, 2″; turret, 13.8″; armament, two 15″; two, 6″. Note the lofty barbette, probably originally intended for number 2 turret of a battleship



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Italian monitor "Fra di Bruno." Displacement, 1,650 tons. Armed with two, long-caliber 15″ guns. The hull was raft-like with the deck covered with inclined armor. The craft did good work in the shallows at the mouth of the Piave

Iron Ores Formed By Bacteria

GEOLOGISTS are realizing more fully as they extend their studies the magnitude of the work done by plants and animals in building up and tearing down parts of the crusts of the earth. Even microscopic organisms perform a large part of this work. Pasteur long ago showed us the deadly power of bacteria in disease and their efficiency in promoting fermentation, but their influence on the fertility of soils and their work in expediting rock decay are still subjects of scientific study.

Bacteria evidently not only aid in the decomposition of rocks and in the formation of beds of chalk and limestone, as has recently been demonstrated, but are active agents in the deposition of some beds of iron ore. Engineers have learned that iron-depositing bacteria may be troublesome pests through their ability to clog the pipes of city water-supply systems with hard, thick crusts and slimy, rusty masses composed of millions of individual bacteria. Mr. E. C. Harder, of the United States Geological Survey, Department of the Interior, who has examined deposits of iron ore in many countries for the special purposes of determining their mode of origin, has recently made close studies of the action of bacteria in forming iron ores. He has found the so-called "iron bacteria" actively engaged in the deposition of compounds of iron not only in surface iron-bearing waters but in mine waters to depths of several hundred feet and has made laboratory cultures of various iron-depositing bacteria. The results of these studies have just been published by the Survey as a paper entitled "Iron-depositing bacteria and their geologic relations."

Mr. Harder describes the iron-depositing bacteria, gives the results of his laboratory experiments in bacterial iron deposition, considers the probable extent of the influence of bacterial action in forming deposits of iron ore, and gives a bibliography on the work of bacteria in rock and ore deposition.

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

For the Preservation of a Vital Industry

THERE is a term, "Key Industry," which has been so greatly used in the discussion of post-war conditions in the industrial world, that it may as well be defined at the outset of this discussion, even though it might seem to be self-explanatory. A key industry is one which is so intimately related to other industries as to be vital to their success. Conspicuous among these is the manufacture of scientific instruments, laboratory apparatus, laboratory glassware, and laboratory porcelain ware.

No great modern industry, such for instance as that of steel manufacture, is complete without its highly organized and thoroughly equipped laboratory. The superintendent of such a plant, or whomsoever he may delegate as guide, after showing the visitor through all its various departments, will reserve for his final inspection the laboratory, with its fascinating array of delicate apparatus and its corps of highly trained experts. And when he has completed the inspection he will feel, if he is truly discerning, that right here is the very nerve center of the whole enterprise.

And if one could follow the product of the steel mills, as it is distributed throughout the thousand-and-one industries that are embraced by the term mechanical engineering, he would find again, that the turning out of the finished product to meet the exacting terms of the specifications, is largely controlled by delicate instruments of precision, some of which are capable of gaging the accuracy of the finished work to so many thousandths of an inch.

And if he followed the product out into the field, he would find, as in the case of the costly guns, both naval and military, upon which in the event of war, the security of the country depends, that their efficiency is absolutely dependent upon certain optical instruments, whose materials and workmanship must be of the very highest quality.

Now when the war came upon us, with its imperative demand for a vast and immediate increase in industrial production, not merely in two or three but in practically every leading industry of the country, the amazing fact was disclosed that for practically the whole of our laboratory equipment, and very largely for instruments of precision as used in the manufacture and operation of artillery, we were almost entirely dependent upon foreign manufacturers, and chiefly upon our principal enemy, Germany.

The story of how the crisis was met has been told in the columns of the SCIENTIFIC AMERICAN. Suffice it to say, here, that the manufacturers of the United States, assisted by the scientific institutions, Governmental and private, applied themselves so resolutely to the task, that they not only kept pace with the demand, but ultimately succeeded in equalling, and in some cases excelled, the best product of the long experienced and highly expert German factories.

Now that the war is over and trade with Germany has been resumed, these valuable industries find themselves confronted by their German competitors, and because of the cheaper European labor, it is certain that the American manufacturer will be undersold. If so, these industries will languish, and it will be only a question of time before our laboratories will again be dependent upon our late enemy for their equipment.

It is to remedy these conditions and safeguard our infant industries that a bill is now before Congress, for subjecting all imported glassware and porcelain ware for use in the sciences, or in analyzing or testing, or for use in education, to 60 per cent duty, optical glass to 45 per cent duty and philosophical, scientific and laboratory apparatus, utensils, instruments, etc., to 45 per cent duty.

We commend to our readers a study of the testimony given before the Committee on Ways and Means of the House of Representatives on this most vital subject in connection with a bill, whose object is the saving and maintaining of these threatened industries. It is impossible to deal, here, at any length with the illuminating data presented; but the general conditions were well summarized by Mr. Chester G. Fisher of Pittsburgh, representing the scientific instrument makers of this country. Before the war, he tells us, 80 per cent of all the scientific apparatus supplied to our laboratories was made in Germany, where this industry had developed to a high state, not because of any special ability of the Germans, since we are 35 per cent more efficient than they are, but because the German factories had the quantity orders to make the industry attractive to them, and their labor costs were low. The quantity orders for scientific instruments were largely being furnished them by American colleges and scientific institutions, because for 12 years our tariff has permitted them to import all scientific instruments free of all duty.

As showing how this is a key industry, or "Master Key" as he phrased it, Mr. Fisher enumerated the following industries that felt the pinch of the lack of laboratory apparatus: The oil refineries, supplying fuel and lubricants for trucks, tanks, and aeroplanes, the tanneries supplying leather for shoes, the shops making forgings for automotive engine parts and for guns, the powder companies and others making high explosives, the chemical factories making the raw materials for explosives and for chemical warfare gases, the food-product concerns, the sugar refineries, the coal-producing concerns, the coke ovens, the gas companies, the cement plants, the cotton-seed oil plants, fertilizer makers, turpentine and resin industries, all felt the pinch of the lack of laboratory apparatus, because in every one of these industries the entire process of manufacture is controlled by a laboratory where a very few men using instruments costing an insignificant amount, guide the production of billions of dollars' worth of material.

England faced the same problem. Before they went ahead, the English manufacturers asked the Government to pledge itself to protect the industries they would have to develop. The pledge was given and has been redeemed. Our own manufacturers went ahead without making any such stipulation; and every consideration of patriotism, fair play, and political sagacity demands that our own Government should extend a like protection to the American manufacturer.

Problem of the Discharged Tuberculosis Patients

THE need of a place where discharged patients of sanatoria for the treatment of tuberculosis may live with their familes and do, under favorable conditions, the work for which they are best fitted, has inspired a plan for a model city different from anything yet attempted for the amelioration of human ills. This city would conduct its municipal affairs somewhat after the manner of the commission form of government, but its industries would be arranged solely to suit the capacity of workers not strong enough to meet the demands of competitive life.

That there is need of such a place is plain. At present tuberculosis patients spend from three to six months in a sanatorium, then go back to their old work, sometimes to the very occupation and housing conditions that caused their affliction. Naturally, in many cases the disease that is pronounced cured or arrested, reasserts itself. Figures covering a five-year period, and taken three years after the expiration of that period, reveal that 373 men and women discharged from sanatoria only 53 per cent were working.

At first it was suggested that an agricultural community would meet the needs of sanatoria graduates. This idea, however, was rejected for the reason that many such graduates could do a limited amount of indoor work with more safety to themselves than they could do any kind of farm work. So the idea of a combined agricultural and industrial community under a municipal government was evolved.

The plan agreed upon, and now recommended by the advisory committee of the National Tuberculosis Association to the Federal Board for Vocational Education calls for the purchase of 1,000 acres of land within 200 miles of a large city. Most of this land is to be prepared for cultivation, but thirty acres are to be given over at once to immediate village improvements. After the stone sidewalks and electric light plant and other modern conveniences would come 100 cottages for workers and their families, an administration building, hospital, fire house, printing establishment, factories and so forth.

The city in mind would care for a population of from 3500 to 4000, but the immediate necessities set forth are for a community of about 600, of whom 220 would be workers, whose families would comprise a large part of the remainder of the population. Costs have been carefully figured by architects, consulting engineers, practical farmers and the dean of an agricultural college. They report that the initial development would require $1,643,698.

How and where the necessary funds are to be raised is still under discussion. The men behind the plan rightly fear to intrust its fate to a governmental agency, because of the danger of political meddling and interference. Therefore, it is proposed that the money be sought from the private agencies that did such effective work in supplying wartime needs. The funds so obtained, according to the plan, would be turned over to a board of trustees made up of two business men, a medical expert in tuberculosis, a lawyer and an educator. The trustees would purchase the land, let contracts, invest funds, and lay down a fundamental policy to guide the community's executive staff.

Here is a most worthy plan which we heartily commend to the practical sympathy of the American public. Such an organization, inspired by the nobility of its work, could undertake the creation and establishment of the model city methodically and scientifically, and with a good prospect of making it self-supporting in a comparatively short time.

Drastic Disarmament

GREAT Britain is reducing her Navy in a most drastic way. Since the war she has sold or condemned over one hundred and fifty ships, and the most amazing part of this disarmament is the fact that it includes every one of her big fleet of predreadnoughts. She has retained the "Lord Nelson" and the "Agamemnon," presumably on the ground that their armament of four 12″ guns and ten 9.2″ guns puts them in the semi-dreadnought class.

The sweeping character of this disarmament affords food for thought by our Navy Department which is asking Congress for funds to bring our own predreadnoughts into fighting shape. With the single exception of the "Hood," Great Britain has stopped work on all capital ships, that is, on all battleships and battle-cruisers. We, ourselves, on the other hand, have six battleships and six battle-cruisers under construction.

Dispatches report that the first Lord of the Admiralty is endeavoring to cut the present expenditures in half. The future Navy is to include only dreadnoughts, battle-cruisers, light cruisers, destroyers and submarines. All other ships are to be ruthlessly scrapped. Although all the capital ships that were under construction during the war, including the "Anson," "Howe" and the "Rodney," 42,000-ton ships, sisters of the "Hood," that were building at the end of the war, have been discontinued, 36 of the smaller vessels, scout cruisers, destroyers and submarines will be completed.

Electricity

Wireless Station for Madeira.—The Portuguese Government is considering purchasing from the British Navy the wireless installation now at Madeira for Porto Santo, and procuring a more powerful apparatus for Madeira. Firms interested are invited to communicate with the Minister of Commerce, Libson, Portugal.

Lamp Caps and Glare Shields.—An American manufacturer has recently introduced a line of opal-glass lamp caps and glare shields for industrial lighting use. The lamp caps are made of opal glass having good diffusion with low absorption of light. They closely fit the bulbs of gas-filled lamps, being held in position by coiled spring holders, and conceal the lamp filament and further cut down glare. The caps are specially fitted for use with reflectors that would not otherwise afford sufficient eye protection.

New York Electrical Show.—The Electrical Exposition and Motor Show is to be resumed in New York this year, opening at the Grand Central Palace on September 24th, according to *Electrical World*. This will be the first show since 1917, last year's display having been omitted because of the war. In announcing the resumption Arthur Williams, president of the Electric Show Company, said that while there had been some uncertainty as to the time and place of the exposition, there had never been any doubt that the first year of peace would see the exposition back in its accustomed place. In fact, the show plans began to take form soon after the armistice was signed. The Grand Central Palace was used during the war as a debarkation hospital. An indication of the importance with which the electrical industry regards this show is seen in the fact that 40 per cent of the space had been assigned to exhibitors before the date of the exposition had been finally settled upon.

Choking Coils for Earthing.—W. Petersen has investigated the disturbances due to the earthing arc on high-tension networks. He considers that a large number of breakdowns in the continuity of supply are due to the earthing current and the grounding arc. The earthing choking coil may be used for a double purpose, viz., to reduce the earthing current to minimum and to suppress the arc. This choking coil may be connected to the generators or transformers; alternatively, it may be connected to the artificial neutral point of the system. It absorbs that part of the earthing current which is due to capacity, and renders the remaining part of the earthing current incapable of generating an arc if it receives from the voltage of the phase a current of the same magnitude as that part of the earthing current due to capacity. The physical peculiarity of the coil lies in the fact that its property of extinguishing the arc depends essentially on the equality of the frequency in the network and that in the discharge wave. The author gives in the *Elektrotechnische Zeitschrift* an account of some tests and experiments which he has conducted on the network of the Laufenburg power station.

Electricity from the Wind.—During the coal famine caused by the war many attempts were made to improve the working of the windmills geared to dynamos to generate electricity. About 250 installations on farms and small estates have proved fairly satisfactory. Many experiments in this connection were carried out by the late Mr. P. La Cour, and a trial mill designed by him is still being used for observation purposes. During about one-third of the year there was either complete absence or excess of wind, and the force available was very variable. It was nevertheless found possible to save fuel for steam or gas-driven power producers. The cost per kilowatt from peat gas fired plants is approximately the same as from a windmill-driven installation. Attempts were made to design special three-phase dynamos capable of maintaining constant voltage independent of the speed of the mill, special attention being also paid to automatic adjustment of the sails in order to reduce the cost of attendance. A mechanical contrivance effects a turning movement of the sails so that during very high winds these occupy a position parallel to the direction of the wind, continues *Electrical Review*, thus avoiding damage to the mill. Attention has also been paid to gearing and bearings to minimize losses in transmission from the sails to the dynamo.

Science

The Ramsay Memorial.—It is announced that rapid progress is being made toward the completion of the fund of £100,000 which it is proposed to raise for founding a memorial to the late Sir William Ramsay. The cash in hand already amounts to £43,000, which is said to be probably the largest sum of money ever raised in honor of any man of science. Part of the money is to be used in founding a laboratory of chemical engineering at University College, London, and the rest in establishing Ramsay Memorial fellowships.

A Useful New Parasite.—A recent bulletin of the U. S. Department of Agriculture states that a European parasitic fly, *Compsilura civcinnata* has been used with great success to destroy gypsy moth and brown-tail moth in New England. It will also aids in the control of other insect pests. A few years ago the white-marked tussock moth was a serious pest in New England, but has practically disappeared since *Compsilura* became established. The cabbage worm, the celery worm and the fall webworm have all been reduced by the activities of the new parasite.

Anti-Tuberculosis Campaign in France.—The Rockefeller Foundation reports that its Commission for the Prevention of Tuberculosis conducted an energetic campaign last year in France. Three traveling exhibits and groups of lecturers visited 10 departments, and in 141 towns of 3,000 or more population gave 875 lectures with demonstrations and exhibits. During the year more than two million pieces of printed matter, posters, pamphlets, postcards, games, etc., were distributed through the whole of France. It is stated that the Commission's publicity material, written by French men and women and charmingly illustrated by French artists, has set a new standard for popular public health education.

Difficulties of Sounding an Asphalt Lake.—According to the *Engineering News Record*, July 17 1919, recent borings made in the asphalt lake on the Island of Trindad have reached a new low level record of 150 ft. The previous record, made in 1893, was 135 ft. On both occasions the asphalt was found to be of uniform character throughout. Great difficulties attend any attempt to sound the lake, as it is in constant although almost imperceptible motion. The pressure of the mass of asphalt against the drilling apparatus causes it to bend, and the deflection makes further boring impossible. After completion of the test, the hole was observed to shift at the surface 25 ft. in six weeks. The movement was shown to exist to a depth of 100 ft., and there was evidence that the direction was reversed at a depth of from 25 to 50 ft. The movement of the asphalt is believed to be similar in many respects to the ascending and descending currents in a kettle of boiling water.

Educational Uses of the Topographic Atlas Sheets.—The fact that the U. S. Geological Survey is publishing, in thousands of sheets, a large-scale map of the United States is by no means so well known to the public as it should be, considering that this work has been in progress for forty years. The various "quadrangles" of this map, mostly on scales varying from 1 inch to 4 inches to the mile, ought to be in everyday use in all parts of the country for which such sheets have been published. The efforts of the Survey to increase the use of these maps by placing them on sale at postoffices have not, it is said, proved very successful. On the other hand, the maps are extensively used in schools. The utility of these maps in illustrating lessons in physical geography is brought to notice in a circular lately published by the Survey. Here we find descriptions of certain sheets representing widely scattered regions of the country and furnishing examples of a wide range of topographic features. One area, in Arizona, shows a valley in which "streams wither away without forming a main stream." Another shows a stretch of California coast, "whose shore-line is irregular, with numerous rocky stacks lying just off shore," and the adjacent country rising to a well-marked terrace. Several sheets illustrate the effects of ancient glaciation. A Washington sheet shows a symmetrical volcanic cone, on whose flanks are more than half a dozen glaciers. In short, an endless variety of material for classroom use is furnished by the Topographic Atlas Sheets.

Aeronautical

A Motorless Flier.—During the war the competition for the Peugeot prize of £400 for a flight of 10 meters carried out with no other motive power than that furnished by the pilot, has been in abeyance. Recently, however, interest in it has revived and there has been a lot of strenuous practicing lately. A message from Paris on August 11th announced that the well-known French cyclist Poulain at Longchamps had made a hop of 12 meters at a height of 1 meter, his speed, as reported in *Flight*, being 9 kilometers an hour.

Super-Chargers and Height Records.—Good results are being obtained with aero engines equipped with super-chargers. Thus in France several notable altitude flights have been made with engines equipped with a Rateau super-charger, while in the United States Major Schroeder recently made a remarkable altitude flight with an engine equipped with an American type of super-charger. The object of the super-charger is to maintain the pressure on the carburetor during the ascent while the air is getting more and more rarefied.

Flying Through an Arch.—In defiance of an official interdict a Frenchman, Charles Godefrol, has succeeded in flying through the Arch de Triomphe, the feat which even the French have been moved to term a foolish feat and in practicing for which Navarre lost his life. The flight was made soon after 7 A. M. on a Nieuport of 9 meters span, fitted with a 120-horse-power LeRhone motor. The height of the opening of the Arch de Triomphe is 29.42 meters and the width between the pillars 14.62 meters. Godefrol flew up the Avenue de la Grand Armee through the Arch to the Concorde where he managed to get above the trees and turned back to Villacoublay.

The Lawson Passenger Carrier.—The Lawson biplane which has recently attracted much attention through its long-distance passenger-carrying flights is one of the largest American machines in existence, and marks another step forward in commercializing aviation. This machine is equipped with two Liberty engines. The wing spread is 95 feet, and the length of the body is 50 feet. The speed is given as 90 to 100 miles an hour, and one engine is sufficient to maintain the flight in case the other breaks down. With a full load of passengers and a large cargo of mail or other material, this machine will climb 4,000 feet in ten minutes. It has a ceiling of 15,000 feet. The Lawson machine has a carrying capacity of 26 passengers.

Long Glides.—What is believed to be a world's record for gliding with a dead motor was accomplished at Ithaca, N. Y., in a Thomas-Morse two-seater biplane. This machine flew to the head of Cayuga Lake, a distance of 35 miles, and having attained a height of 17,500 feet, the pilot switched off his motor and glided to Ithaca, at which point he still had 5,000 feet altitude. If his glide had been continued it is estimated that an additional 15 miles could have been covered, making a total of 50 miles without the use of his motor. The longest glide previously recorded was that of Capt. Raynham, according to *Aeronautics*, when he glided from Brooklands to Hendon, in England, a distance of 22 miles.

Smugglers and Germany's Winged Police.—According to a story from Berlin an attempt to smuggle 20,000,000 marks to Switzerland from the German capital was frustrated by the action of aviators. The smugglers left Berlin on the afternoon of August 18th by the Basel express. When the police received this information three airplanes started off in pursuit, and succeeded in overtaking the train at Nurnberg, where the smugglers were arrested. In the reorganization of the German police system the authorities are evidently determined to bring it right up to date. It is stated from Berlin that a network of aerial police patrols has been organized, one of the chief duties of which will be to prevent the migration of capital from Germany, in addition to fighting against criminals generally. A landing place for police airplanes is already being laid out on the Swiss frontier. Similar establishments are planned for Hamburg, Breslau and other towns.

Chaining the Missouri

How the Tubular Concrete Pile Has Been Used to Check the River's Inroads on Its Banks

By H. T. Dobbins

AN engineering problem that vexed railroads and property owners in the Missouri valley for years and which had to do with handling the erosion of the river has been apparently solved. As with many other problems of this character, the answer was found to have been a simple one.

The Missouri River carries for the greater part of the year a current somewhat exceeding in swiftness that of the average stream, and by reason of the facts that for a large part of the way it travels through a broad valley and that where it does flow beneath high banks these are entirely of dirt formation, it has caused immense damage in years past by reason of changes of channel. In the upper reaches of the river it has forced a number of towns to execute a quick retreat from the occupancy of its banks. Half a dozen town sites, in the last few decades, have disappeared into the river along the Nebraska side, and at the present time the engineers have a fight on their hands to save the rather considerable town of Decatur.

The tendency of the river in the freshet season to cut new channels has shifted the boundary-line location between Iowa and Nebraska so that parts of Nebraska are actually on the east side of the river and parts of Iowa on the west side. Its cutting power is greatly enhanced by the heavy cargo of silt and sand that the waters carry. Thousands of acres of river bottom land have been swallowed up by the river in the past, and government engineers vainly sought, by applying known methods, to prevent this great waste.

The solution has finally been found in the use of the Bignell reinforced concrete pile, which was described at length in last week's issue of the SCIENTIFIC AMERICAN. This pile is so constructed that it can be placed to any desired depth. It is fitted with two pipes, one two-inch and the other four-inch. The smaller is enclosed within the larger, and emerges at the point of the pile. The larger pipe has vents opening at intervals along the sides of the pile. From a steamboat anchored above, streams are forced through the pipes at a strong pressure, that at the point boring a hole in the sand bottom and that pouring from the upward-turned openings of the vent removing the pressure upon the sides and carrying the silt to the surface.

Sinking concrete piles and tying cottonwood trees to them to form a barrier protecting the banks of the Missouri from the current

In river-bank reclamation work, before the pile is put into place a four-inch steel collar is placed about the upper end. To this collar are attached 1½-inch steel cables, fifty to a hundred feet long; tied to the other end of the cables are trees. The pile is then sunk to a depth of twenty feet below the river bed. This leaves the trees, dozens in number, floating in the current. As the river carries a large amount of sand in solution, when the current is slowed by the use of the trees this silt is deposited and in a brief space of time a sandbar is formed. These bars form an absolute protection to the banks and have the effect of confining the river in any channel designated by the engineers.

LAST week we described the reinforced concrete pile that is sunk by means of jets of water, without the action of a pile-driver. In the accompanying article is to be found an interesting story of how this pile has been used to keep the Missouri River where it belongs, and save much valuable land from destruction.—THE EDITOR.

The inventor, Edward Bignell of Lincoln, has long been superintendent of a division of the Burlington Railroad on which are located a number of bridges, and his piling was the result of the necessity of solving the problem of sinking piles to a greater depth than it is possible to drive the ordinary oak. On the east bank of the river, opposite Omaha, the Burlington has shops and property investments of a considerable amount that were supposed to be secure from any attack of the river. Over a year ago a sudden turn in the channel menaced this property, and after thousands of dollars were spent in the approved methods without result, the Bignell pile, with the swinging obstructions in the current was tried successfully.

This brought the Bignell pile to the attention of one of the largest real estate operators in the West. If the pile could save the Burlington's property it could save land anywhere along the river. After its success had been established by the railroad, the real estate people bought up a large frontage of rich bottom lands that had been going into the river at the rate of about 200 acres a year. They were able to do this for a small figure from property owners who despaired of saving their land. They have placed along the river front a number of these obstructions, and have not lost an acre of land.

The accompanying pictures will give a clear idea of the operation of this method of protection. The first shows 161 trees fastened to one Bignell pile. The water was 22 feet deep and flowing eight miles an hour where this obstruction was placed. The pile, a twenty-foot one, was sunk twenty feet below the bed of the river. The steel cables, six of them, each 100 feet in length, were attached to the collar on the piling

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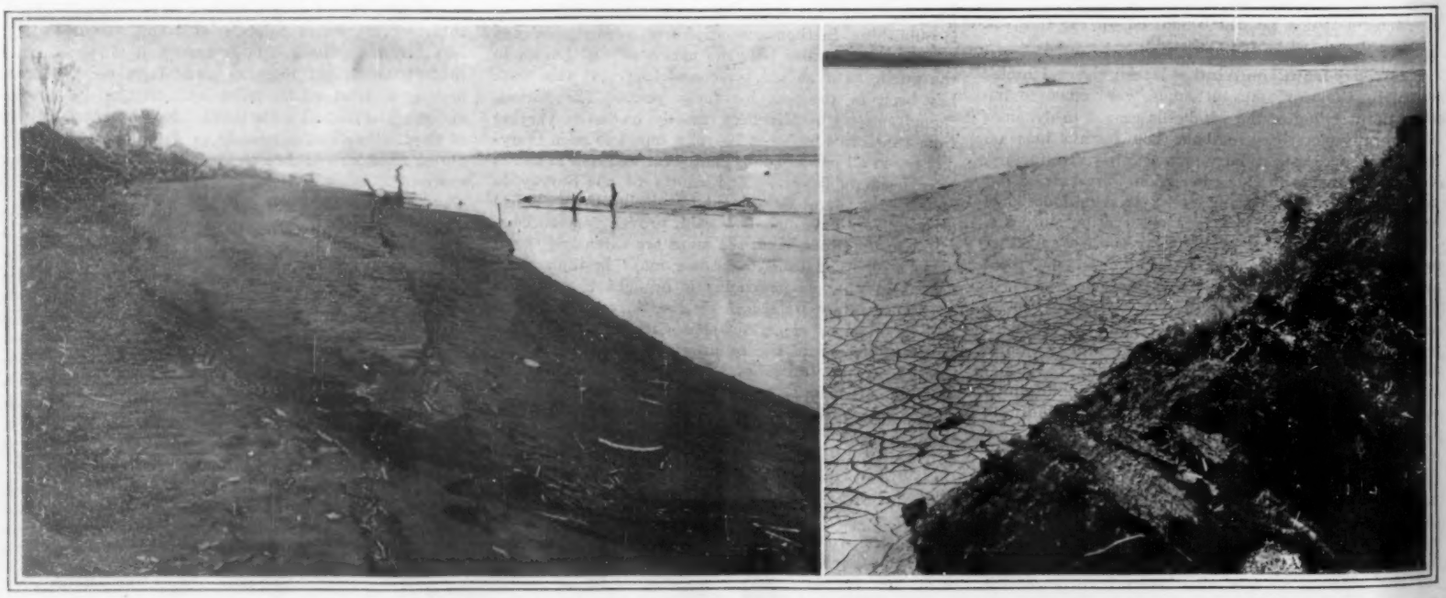
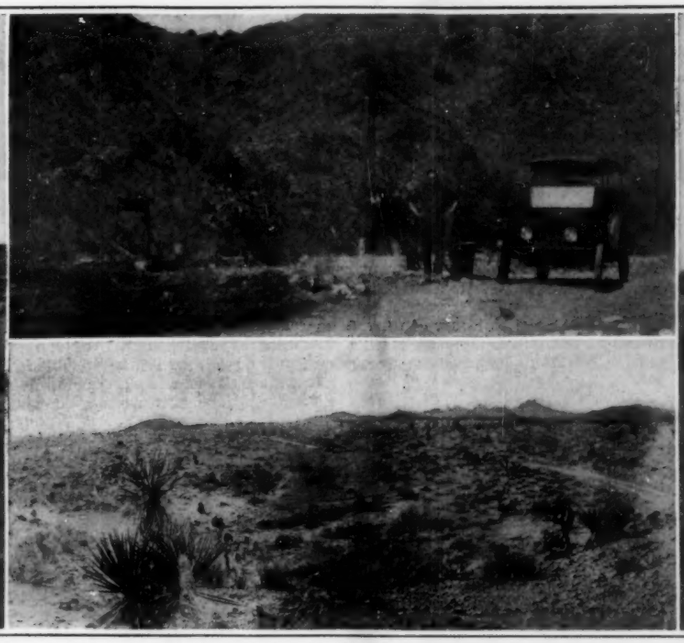


A piece of Missouri River bank that was rapidly disappearing (*left*), and the permanent bar (*right*) that resulted from the use of concrete pile and barrier of trees

The first Federal sign post in the Arizona desert



Above: A desert watering station in Arizona
Below: A characteristic bit of desert scenery

Government exploring party locating desert watering places

The Desert Sign Post

Opening Up America's Waste Lands by Aid of the Painted Word

H. C. Hardy

Photos by United States Geological Survey

THE days of the "prairie schooner" are past, but some of the perils of the desert still persist in parts of the United States. They menace the traveler venturing upon a vast fan-shaped arid waste that converges at a break through the Sierra Nevada Mountains leading into the wonderfully fruitful coastal region of southern California. This territory of scorching sunshine, scanty vegetation, and widely scattered water holes covers an expanse of 570,000 square miles—nearly one-fifth of the country's total area!

Just as it did decades ago, when the tide of our fearless pioneers moved persistently westward, this expanse of desert still stands directly athwart the lines of railways and the roads of motor vehicles feeding northward and eastward for hundreds of miles from the land of plenty to the far less favored sections in sister States. Now, more than ever, is it essential that the crossing of this inhospitable tract, this realm of awful dryness, be robbed as much as possible of its menacing nature. The motor truck as an aid to intercommunication, as a medium in lessening the cost of living, must, more and more, traverse the interposed desert sweep; and this the power vehicle cannot do unless water be available at convenient points en route. Not only that, but the welfare of passengers and those in charge of this service is equally dependent upon the certainty of finding a sufficiency of water along these highways.

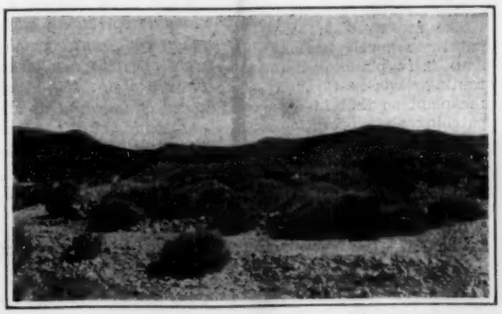
Until very recently the known water holes and springs were indifferently cared for, and many lives were needlessly sacrificed because their whereabouts were not indicated by any marks that would serve to guide the wanderer afoot or riding. Frequently the sources of relief were hidden amid scanty growths of desert vegetation or concealed in a dip of the land that quite failed to give any hint of the presence of water. Men and animals died quite as often within a few hundred yards of a well as they did with the spring miles away from them. Suffering from intense thirst, which unhappily promoted bewilderment, they wasted their strength in aimless hunting where husbanded energy helped by proper guidance would have led to the vitally necessary water.

It was because of this condition that George W. Parsons, of Los Angeles, bestirred his State to action to the extent, at least, of planting signposts in some parts of California's arid region. Carrying his humane propaganda farther, he finally induced Congress three years ago to make a modest appropriation looking to still wider work in surveying and marking desert watering places throughout the entire tract, which also concerns Utah, Nevada, Arizona and New Mexico. Mr. Parsons had previously learned by his own experience what it meant to put up with a lack of water in those parched lands; and as a qualified prospector he was keenly alive to the potential value of the mineral wealth located in that vast area. So long as the available water holes were allowed to be contaminated by the heedless or their whereabouts were known to but a comparatively few persons, Mr. Parsons was conscious of the fact that every stranger courted death when he ventured afar into that austere domain.

By act of Congress, approved August 21, 1916, $10,000 was appropriated and the Secretary of the Interior was authorized to use that sum as far as it would permit in discovering, protecting, and rendering more accessible to the traveler the water to be found on the arid public lands of the United States; and, after doing this, to erect and to maintain suitable and durable monuments and signboards, placed at intervals along and near the accustomed lines of travel over the desert, so that persons traversing the territory should be able to reach by the shortest routes the nearest springs, streams or water holes.

As far as that modest grant permitted, the field parties of the United States Geological Survey did their share, and, in addition, used some of the regular allotment made to the survey for the purpose of investigating ground water conditions. The region surveyed last year occupied about 60,000 square miles in southern California and southwestern Arizona, representing only a small percentage of the entire area that should be covered in this manner. In California, the section embraces the southern part of Death Valley and the country between this valley and the Mexican border; while the desert area so dealt with in Arizona includes the portion west of Tucson and Phoenix and south of Wickenburg and Parker. This district was purposely selected because it is said to be the

(Continued on page 322)



Two views (left and above) of a spring, hidden away in a clump of desert vegetation, that constitutes the only water within a radius of ten miles; and the sign post erected by the Geological Survey that tells how and where to find it

The Stop-Watch in Industry

Some Reasons for Believing That It Is Out of Place There

By C. E. Knoeppel

IN writings and addresses in the past, I have advocated the use of the stop-watch. I have used it in my professional work. I have instructed others in its use, and have had others use it for me. Some four years ago, however, I began to see evidences of its unpopularity in industry, and began to study the entire situation with the view to getting along without it. Since that time the organization of which I am head has made no use of the stop-watch in its regular work of eliminating industrial inefficiency. We see no use for it in the future, in so far as we are concerned, for excellent results have been and can be secured without its use.

The experience behind this attitude is 18 years as laborer, molder, draughtsman, office manager, systematizer, cost accountant and consulting industrial engineer. The last four years have been spent as head of a professional organization, serving industrial concerns all over the country in the matter of introducing betterments to increase production. This experience has convinced us that the inefficiency almost universally met with in industry, which is the one factor responsible for the high prices we are now fighting, is not all due to the inefficiency of the worker by any means. As a matter of fact the *greatest part of the inefficiency found is due to the shortcomings of management.* Unless a plant is properly organized; unless there are reliable records on which to base conclusions; unless production is properly controlled; unless working conditions and facilities are what they should be, workmen cannot work efficiently, whether they want to or not.

A HUNDRED years ago, when the introduction of the first labor-saving machinery was begun in England, labor revolted with great violence, refusing to operate the machines and crying out that their use meant loss of employment and destitution to thousands of workers. But after three decades of more or less constant violence, the "Industrial Revolution" triumphed; workers realized that increased production was of as much benefit to them as to the employer. Today it seems that we have circled back to the viewpoint of the early eighteenth century, and that labor must learn its lesson all over again. It is perhaps natural that the management should try to drive the lesson home with the stop-watch; but it is not at all necessary to do it this way.

Idleness in equipment; waste in floor space; inadequate manufacturing facilities; too much material tied up in stock; over-equipment; break downs and repairs in equipment during working hours; failure to provide work or material or tools on time; these are certainly factors not within the control of the workers in a plant. This does not mean that there is no inefficiency on the part of the workers, but it does mean that the greatest inefficiency is that of management and that you cannot get a high degree of labor efficiency with a low management efficiency.

Our experience proves further that through efficient organization, proper records, control of production and improved facilities, manufacturing efficiency can be materially increased and in acomplishing these things we have found that no stop-watch is at all necessary.

This brings us up to the matter of the worker's part in industry. There are seven essentials necessary in industry:

(1) Supplying the funds; (2) providing the plant; (3) furnishing equipment; (4) providing an organization; (5) placing orders for work; (6) supplying material; (7) doing the work. In the first of these capital is concerned; the next five fall within the province of the management; labor is concerned with only one of them—doing the work. In this the element of time enters, and the thought behind the use of the stop-watch has been to study this use of time by labor.

It is of course true that labor has felt that the less hours it worked the *more* work there will be for *more* people. In some cases labor has even gone so far as explicitly to take the attitude that it ought to reduce the amount produced per hour in order to "make jobs" for more men. So in our experience we have been observing a three-fold tendency:

(a) Less hours work per man; (b) less production per hour per man; (c) greater wages per hour per man: which is the basis of the vicious cycle of increasing prices.

The stop-watch will never get these ideas out of labor's mind, even if it does show that these conditions exist. Only education and bitter experience will show labor the fallacy of the less-hours-for-more-wages idea. This narrows the use of the stop-watch to:

(a) Determining equivalencies and tasks;
(b) Determining lost motion and waste:

as they relate to the use of time by labor.

We realize only too well the economic importance of increasing hourly production by labor, and that equivalencies must be known in advance so that they may be currently watched and comparisons made. Determining what is a fair hour's work for different operations in industry, what men and equipment can turn out without injury to health or well-being or detriment to equipment, is what is meant by equivalency. This to our mind is an economic fundamental, for if we can secure increased hourly production we need not concern ourselves so much about the matter of wages or the hours of labor. It is altogether a matter of securing production by utilizing every facility that can be invented and every method that can be devised toward getting out a maximum or quantity production. The greater the hourly production the less the cost. The less the cost the greater the demand, and the greater the demand the more business there will be. The more business there is the more demand there will be for labor.

We have found, however, that careful estimates with change in hourly production rates made from time to time, up or down, will ultimately bring hourly equivalents to where they would be if a stop-watch had been used. The logical question arises:—How will these estimates be made if we do not use a stop-watch? *By conferences between those responsible for determining these hourly equivalents, the workers and the foremen, studying the work to be done, plus an analysis of records showing past performance.* In other words, determination of hourly equivalents would be a matter of bargaining, based on intelligent discussion, which would get away from the arbitrary methods so often pursued in setting rates. If subsequent effort proved the hourly equivalent to be beyond the attainment of the worker it is corrected in the same manner as it was set. If the equivalent is too easy of attainment, the same method is followed in increasing it. In other words it is a "Give and Take" proposition. Further, in determining hourly equivalents, the idea is to arrange for an average performance by an average man over an average period of time.

The use to which we put these hourly equivalents is in planning and routing work through the plant so that in dispatching shop operation, as in dispatching trains, we may know the length of time between points and arrange accordingly. They are not used for setting piece rates or bonus times, as in our philosophy the matter of incentives should not be taken up until proper organization, records, production control, proper plant conditions and facilities, and knowledge of hourly equivalents are provided. We have found that if these are provided, any fair method of wage payment will induce the support and coöperation of the worker and enable him to work to better advantage.

It is apparent therefore that the stop-watch is not needed in determining hourly productions, as intelligent estimates based on proper discussion and a study of the work, will serve in the long run to make equivalents as accurate as if determined by stop-watch study. In determining lost motion and waste the steps above outlined will do much to locate and eliminate them. To control production adequately it is necessary to perfect organization, to provide records, and to study and better equipment and facilities, which in themselves will do much to increase operating efficiency. Therefore, if the stop-watch is not a factor in the one case it is certainly not a factor as regards the other.

We have no quarrel with those who advocate the use of the stop-watch. Refinements in results can undoubtedly be secured through its use. As a basis for determining bonus times and piece rates it may have a place in industry, although our experience shows that by the time we are ready for the matter of rates and times on which to base earnings, hourly productions will have been reduced to a practical basis of sufficient accuracy for the setting of rates. The stop-watch can in many cases be used in determining what equipment should do, although in this it has been our experience that mathematical calculations will determine what equipment should do on a given piece of work. We have simply found through our own experience—and this is our best teacher—that we have been able to operate to advantage and secure satisfactory results in industry without the use of the stop-watch.

With labor opposed to it, as well as many managements, it became clear to us that in the long run there would be little gained in attempting to force its use on industry, especially after we had demonstrated to our own satisfaction that there was sufficient to do in eliminating the inefficiency of management resulting from faulty organization, improper records, lack of production control, inadequate shop facilities, faulty working conditions and failure to know hourly equivalents, the betterment of which would make it possible to pave the way for greater efficiency on the part of the workers, without setting tasks for bonus or piece work. It is true that many times the criticism on the part of labor and management has not been so much against the stop-watch itself, as the use to which the results were put; and it might be said that determining hourly equivalents by the estimate and conference method is but another way of attaining the same end. Our feeling as to this, however, is that to get more production it must first be controlled; that to control production properly it is essential that we know within practical limits the time a given piece of work should take, so as to plan to have equipment, labor and material ready at the right time; and that it is just as much to labor's interest as that of the employers' to reduce idleness and lost time to a minimum.

It seems to those of us, who have studied this subject for several years past, that by eliminating the stop-watch and making a clean-cut separation between the inefficiency of management and the inefficiency of the workers, the way is paved for a better relationship between workers and employers, and the increasing of industrial efficiency all along the line.

FROM seventy-five to eighty-five per cent of the possible results from modern methods of industrial management can be secured without the use of the stop-watch in timing workers and studying operations, says Mr. Knoeppel. This may seem a startling statement, especially coming from one who has always heretofore advocated the use of the stop-watch. It represents a reversal of judgment as sincere as it is complete; and coming at a time when it may serve to focus the attention of both workers and employers on the absolute necessity of greater production, its bearing upon the present price situation is very real.

Making a New Nation

WITH the signing of the peace treaty Poland has received universal recognition as an independent State, though the eastern boundaries are still unsettled and a constant irregular warfare is being kept up with the Ukraine and Bolshevist Russia. The problem now confronting the Polish Government of restoring Polish industries and rebuilding the devastated areas is a very serious one. The country has 5,000 miles of railways but only a few cars or locomotives. An order for 150 locomotives has recently been placed in this country. Large purchases for shoes, clothing, textiles, and manufactures are being made in France and Great Britain, both by the Polish Government and private firms, the rate of exchange making it more advantageous for the Poles to buy in these markets than in the United States, where payment could not be made in francs or pounds.

Research in Refractories

Some of the Mistakes Which Are Avoided by Full Use of What Science Can Tell

As in all other branches of manufacture, there has been an endeavor in the refractory industry to produce a more uniform product, compounded on a scientific basis, and made by eliminating the human factor as much as possible. This is in marked contrast to the practice fifty years ago, when the requirements were not so severe. At that time the methods of manufacture were almost entirely hand-processes and many vital operations were left to be controlled by the eye. Naturally a variable product resulted.

The refractory-products plants are located for the most part in certain firebrick centers where refractory materials occur more or less abundantly. Because of this fact operators have been able to judge the good and bad material of a certain district with great accuracy by simple methods, knowing by experience how it behaves in service. It has not been infrequent, however, that such empirical methods have failed, plants having been erected on the supposition that high grade material was available. In one case approximately $500,000 was spent before the company realized that the material for which they were seeking was not present. This might appear to have been a clumsy mistake at first sight, but not so to those familiar with the geology of "flint" clays, so called because of their hard structure and flinty appearance and fracture. The plant referred to was built in the center of a flint-clay region and was surrounded by thousands of acres of territory apparently underlain with flint-clay. It is a peculiarity of such material, however, that it may, due to some freak of formation, become exhausted with only an hour's notice—when apparently unlimited supplies are available.

Nowadays, however, cones varying from ½ to 1 inch in diameter are taken from the ground at regular intervals and are analyzed and tested for refractoriness. To those familiar with the clays of the vicinity under examination, such comparative tests tell the quality of the vein, the thickness, its extensiveness, and even the uses to which it can be put. In fact, the engineers can draw very accurate maps of the holdings of the company, which indicate for periods years in advance where the poor material, if present, will be found and how to locate it. This is in rather remarkable contrast to the old rule-of-thumb method, and has been put into practice by several companies during the past year.

This same method has also failed in other respects, for it is quite natural that miners who are familiar with clays of one district will form definite conclusions regarding its appearance—opinions which do not apply to other districts. As a result, poor clays have been unconsciously mined, while superior clays were disregarded. Since it costs from $0.75 to $1.50 per ton to mine this material, it can be readily seen how from $50 to $100 per day could have been saved or wasted by even the smallest of plants because of the failure of rule-of-thumb methods. The methods previously mentioned are now being applied to the different deposits, the clay from the top to the bottom being sampled, tested and tabulated as to its value. This often results in rejection at the mine, yet more frequently has led to the mining of previously rejected clay at a very small cost, making possible a saving of from 2 to 4 per cent in the total cost of production.

The preliminary examination of deposits is, however, but a small factor in the manufacture of fire-brick. It is important to know the proportions in which the different clays shall be used for different purposes, the fineness to which they shall be ground, and the process by which the tempered mix shall be shaped. It has been the work of an Industrial Fellowship in operation at the Mellon Institute in Pittsburgh in many cases to determine these factors, the brick being manufactured at the plant according to recommendations and tested in the laboratory in the necessary way. By such a procedure the relative density, resistance to heating and cooling, resistance to slag penetration, conductivity and refractoriness, can all be determined and the most desirable product installed in the different furnaces without the cost of plant experimentation. This has been done in the case of checker brick, side-wall brick, roof brick, blast-furnace brick, ladle brick, and bricks for general mill and factory service. Besides this form of laboratory work, considerable investigation of plant problems has been carried out at the plants themselves by R. M. Howe, the Senior Fellow in charge of the research work.

The most important of these investigations has concerned the shaping and burning of the ware. As indicated, the shaping of fire brick was at one time purely a hand process. Later machines were installed which shaped the damp clay (dry-press) or the wet mix (soft mud) or a mixture of intermediate consistency (stiff-mud). All of these processes have advantages but there is a growing tendency in favor of the stiff-mud process. The objection to these latter brick is that they are sometimes laminated because of the friction of the column of clay on the sides of the die through which it is forced. It has been found recently that such lamination can often be removed, when objectionable, by placing the green brick on edge and completely crushing it. The product that is then formed is very similar to the hand-made product, yet can be made very rapidly by machinery. After the ware has been shaped and dried, it is then subjected to very high temperatures or is "burned." This procedure causes it to become very hard and of a more or less constant volume. Burning, however, requires an immense expenditure of coal, amounting to about three-quarters of a ton of fuel per 1,000 brick. By utilizing the waste heat in warming up the cold ware, this fuel expenditure may be cut in half, an economy which saves from ten to one hundred tons of coal daily at the plant. Such practice, however, requires an expenditure of considerable money and the scrapping of thousands of dollars worth of kilns. Hence, the installation of more economical kilns, although eventually probable, is yet but in its infancy. Studies of these kilns have been made by Mr. Howe and his assistants and data are now available which concern their possible industrial applications.

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

Roller Skates for Messenger Boys

To the Editor of the SCIENTIFIC AMERICAN:

Has the idea ever been seriously considered of applying to pedestrian traffic in general through our cities, the well known device of having the messenger boys in factories and larger offices do their errands on roller skates?

Just at the moment the writer can see no objections to this, particularly since rubber tires on the roller skates will cut down the noise to a minimum.

W. B. WIEGAND.

Montreal, P. Q.

The Hartford Weather Kiosk

To the Editor of the SCIENTIFIC AMERICAN:

In your August 30th number, on page 211, is a descriptive article upon the Weather Bureau exhibit of weather forecasting apparatus.

I regret to say the kiosk has been dismantled many weeks, if not months, but the structure remains an eyesore to the passers-by. While the instrument was in operation, it seemed to attract considerable attention, but for some reason the Weather Bureau decided to abandon this method of informing the public of the weather conditions, and has made vain efforts to get someone to purchase the remains and take it away.

CHAS. S. BLAKE.

Hartford, Conn.

Cutting Shoe Bills with a Paint Brush

To the Editor of the SCIENTIFIC AMERICAN:

Three years ago I read of a mechanic who noticed that the soles of his working shoes, which were saturated with the oils that go to make up paint, wore out very slowly, while the uppers of the shoes always gave way first. He took them to a shoe manufacturer who discovered, by analysis, that the oils used in ordinary paint act as a preservative on sole leather. By experimentation the following formula for preserving soles was evolved:

For a pair of shoes that have the shiny dressing worn off the soles, put on three coats of paint—ordinary hard-finish black paint will do—allowing each coat to dry forty-eight hours before applying the next paint. That is all there is to it.

If the shoes are new, with the sole dressing intact so that the paint will not penetrate, roughen the surface with fine sandpaper. The paint will soon wear off the soles, but that which has penetrated the leather will remain and continue to perform its good offices. Repeat the process once each season and soles will cease to worry you; the life of your shoes will be measured by that of the uppers—and this will be greatly prolonged by the elimination of the half-soling process, with its great wear and tear on the edges of the soft leather.

In proof of all this, I can cite a pair of Oxfords which I am now wearing for the third summer. The heels are slightly worn, but they were never painted. I may say, as further evidence of what this showing means, that I walk about for some fourteen or fifteen hours per day.

F. W. CHARLES.

Seattle, Wash.

Tool-Steel Tests

To the Editor of the SCIENTIFIC AMERICAN:

In a recent issue you describe tests of a new tool steel. As I have been connected with the performing of a number of similar experiments as noted in that extract, it seems that a few comments would not be out of place.

The article in question states among other things that "this steel may be heated anywhere between 1650 and 1950 degrees Fahrenheit," which demonstrates that it must be an alloy steel, as an ordinary carbon steel cannot be heated to such a temperature without destructive results. The experiment, however, furnishes an inconclusive criterion as to the quality of the steel. Furthermore the article states that "the chisel can be heat treated so that it can be filed." This to the layman may seem remarkable but any man who is familiar with the heat treatment of steel will verify that a heat treated steel that cannot be touched with a fine file would be too hard and consequently too brittle to be successfully employed for driving through a piece of ordinary steel of moderate thickness as described in the article.

During the past ten years it has been my opportunity to have been connected with the performing of experiments such as described in your article, using however nothing but ordinary high carbon basic open hearth steel as drawn from ordinary 100-ton heats; the steel being, of course, of the proper carbon analysis to be susceptible to heat treatment. On one occasion, early in the year 1913, we had occasion to make approximately 75 sample tests. The tests consisted in driving tapered punches through three inches of soft open-hearth steel. The steel for the punches was drawn out hexagonally from 4-inch-square billet taken from a heat such as noted above and the three-inch-thick blocks were cut from a 3-inch square stock bar of about .15 to .20 carbon. In every case the punches were started into the blocks to the depth of approximately ½ inch with a heavy hand hammer after which they were driven through the remaining part of the blocks under a 2,000-pound steam hammer, until the points of the punches protruded from the under side of the blocks. During the driving under the steam hammer, the blocks were, of course, held in place so that the points of the punches would not come in contact with the bottom die of the hammer. During the tests there was not one failure out of the 75 and in each case the protruding point of the punch was in as perfect a condition as before being driven. The punches were treated before driving so that the heads would not break out or crack.

These approximately 75 tests were numbered and the sample No. 10 which I picked out at random at the time I am sending you for your inspection together with affidavit covering the performance.

In conclusion, the test as expounded in your article does not demonstrate any particular quality of the "Steel Extraordinary" than cannot be similarly imparted to any tool steel on the market.

GEO. PORTEOUS.

Duluth, Minn.

The Lesson of the Caldwell Range

Governmental Encouragement of Rifle Practice in Time of Peace Vital for National Security

By R. G. Skerrett

THE monster "shoot" recently concluded at the Caldwell Rifle Range, New Jersey, may properly be termed the climax of a phase of the work of our fighting fleet of which the general public knows but little—a work, however, that should be continued for the national good. It was from our force of naval reservists that the men were mainly drawn who played a very big part in bringing into being, skilfully outfitting, and then operating the fifteen rifle ranges, established in various parts of the country, where fully 1,200 targets were in service for months in teaching some hundreds of thousands of our citizens how to shoot before sending them overseas. And of these ranges, the biggest and most spectacular is that at Caldwell, located within easy reach of 10,000,000 people.

Instruction in the use of the Colt machine gun

The National Defense Act of June 3, 1916, empowered the Secretary of War to establish and to maintain rifle ranges, and Congress expressly declared that these establishments should be available not only to the army, the national guard, and the navy, but likewise to all able-bodied citizens capable of bearing arms. The purpose, of course, was to teach the shooting of small arms which, in the last analysis, constitutes the fundamental strength of any fighting organization.

The Secretary of War made no responsive move to carry out that particular provision of the National Defense Act; and the marksmanship of our men at the front might have proved deficient in many cases in the hours of greatest trial but for the initiative of Lieutenant-Colonel William C. Harllee of the United States Marine Corps. He it was who induced Mr. Josephus Daniels to take advantage of the chance thus offered the navy and to utilize the funds granted in creating a chain of rifle ranges at strategic points of instruction—these being open to the military services and to civilians, as specified by the National Legislature.

In this wider field of activity, Lieutenant-Colonel Harllee called to his aid the experience gained in promoting rifle practice among the marines. Over a period of nearly a decade he had zealously striven to make our "sea soldiers" a distinctive organization because of their marksmanship; and how well he succeeded was demonstrated at Chateau Thierry and elsewhere on the western battlefront. It was the ability of those "web feet" to stand unalarmed in the face of superior numbers and to deliberately pick off their foes at ranges up to 800 and 1,000 yards that dismayed the Teutons and won the unstinted admiration of their less expert European allies. It was the training previously given those men on the rifle range that made their splendid performances possible. They were not born with that skill—they acquired it by patient, painstaking, and intensive preparation.

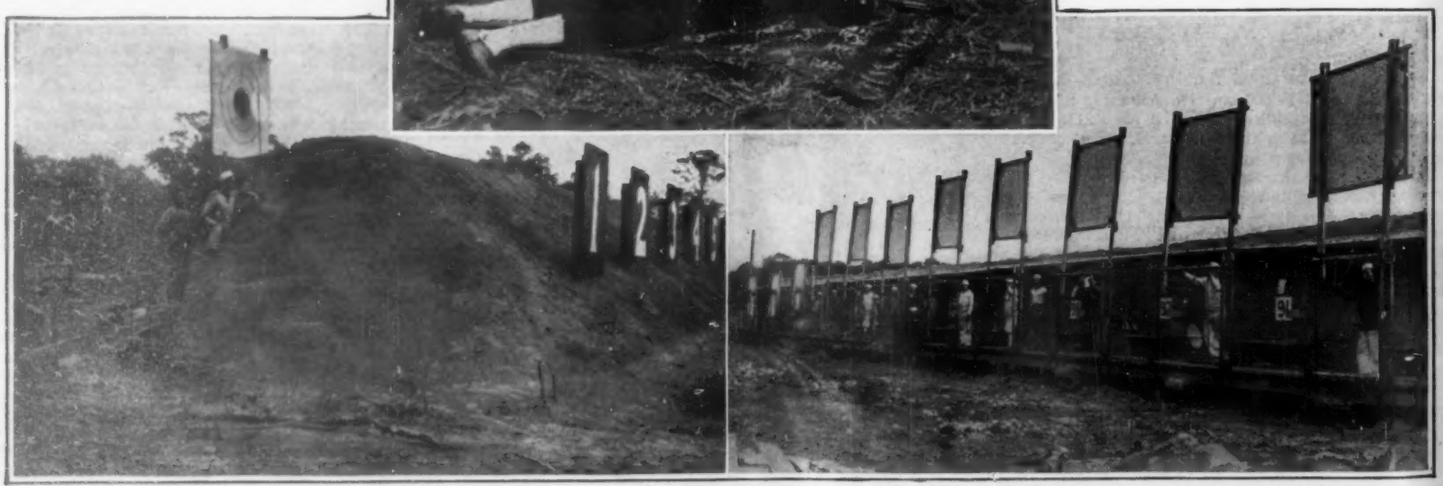
It is not the purpose of this article to tell how the Naval Reservists, under the leadership of Lieutenant-Colonel Harllee, built the various rifle ranges. Their climacteric efforts were centered in making the range at Caldwell the master one of the group, and for the recent matches they rounded out the range so that it could boast its present magnificent array of 220 rifle targets and 50 pistol targets—the rifle ranges having a maximum reach of 1,000 yards. The recent "shoot" has once more emphasized the aptitude of Americans in handling skilfully and effectively the prime weapon of the infantryman; and the world now knows that in the end it is the foot soldier who decides the fate of battles.

During the various contests that have been held at Caldwell in the late period of activities, covering an interval of six or eight weeks, the thousands of participants have not used up more than a few million of cartridges. We have a heritage from the World War of something like 5,000,000,000 rounds of this sort of ammunition, and this stock will deteriorate and be useless if not expended in the course of a decade. It will be quite impossible to put these cartridges to good use in time of peace unless they be utilized lavishly in operating every rifle range today available and stimulating a desire in every able-bodied citizen to learn how to shoot rapidly and surely.

There is a disposition, which has already had expression, on the part of the authorities in Washington to abandon many of the wartime rifle ranges, quite forgetting that it is far easier to maintain a system once established than it is to call it into being again suddenly when urgency demands it. Lieutenant-Colonel Harllee, by his years of work and gradual upbuilding, perfected a course of instruction of peculiar value, and there is more need now than ever to expand its application. Our national security in the years to come will be infinitely better and more cheaply safeguarded if every potential fighter be taught to feel at home in handling the soldier's paramount "shooting iron." The truth is, the marksmanship of our men has stirred military circles abroad, and it is authoritatively reported that the Germans are henceforth going in for target practice as they have not done in the past. Plainly, it is all the more necessary that we should keep up our own good work and make it virtually a form of national sport such as has prevailed for years among the Swiss. With substantially 5,000,000,000 rounds of ammunition to draw upon, it will be practicable not only to operate all of our existing ranges but to build others so that no section of the country will be without its convenient means for turning out marksmen, sharpshooters, and expert riflemen.

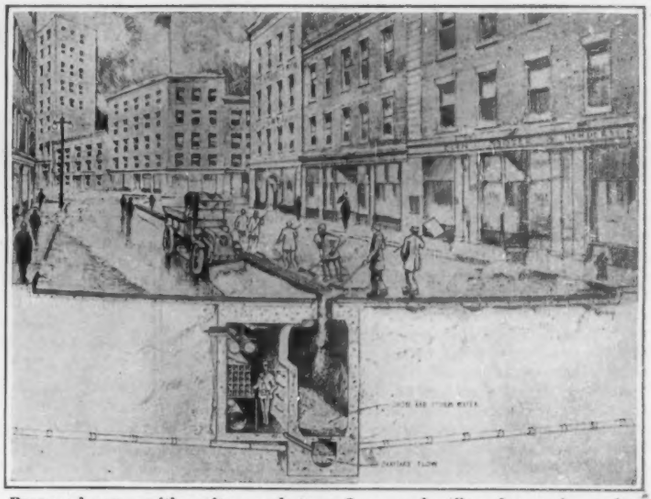
At the fifteen ranges operating during our participation in the war there was instructed monthly an average of more than 30,000 men, and each week there were fired quite 2,000,000 cartridges. Every round was expended under the di-

(*Continued on page 322*)



Above: Training in the sort of shooting that makes a sniper. *Left:* A close-up of the butts. *Right:* Rear view of the targets, showing the elevating gear

Existing sewer in section, showing a typical collection of pipes and conduits for other public services, and a fair sample of the course of present snow removal



Proposed sewer with sanitary and storm flows, and gallery for service mains. The street is depressed at center and snow removal proceeds as indicated

The General Utility Sewer

THE problem of snow removal, always present in our large cities, promises to reach, during the coming winter, a degree of acuteness surpassing anything ever before seen. Not alone is there no body of unemployed workers to fall back upon in the event of snow emergency, but the rates that must be paid whatever labor may be available are such as to strike terror into the soul of any Street Cleaning Commissioner who must pay them, and any Tax Bureau that must provide the funds out of which they may be paid.

There is no escape from the high cost of snow shoveling through the effort to melt it *in situ* and let it run away. This suggestion, attractive enough on its face, is brought forward as regularly as winter rolls around; but when it is reduced to cold, hard figures the heat requirements are such as to make strong men weep, and to put the whole idea definitely out of the running. Accordingly the only means presenting itself for reducing the cost of snow removal is to reduce the length of the haul between the shovel and the dump; and this means only one thing—dump the snow in the sewer.

This, of course, can be done and is done. But it is open to serious objections. The manholes, to begin with, are too far apart. There are not enough points where the snow can enter the sewer; congestion results in the street around these points, and even more in the sewer beneath them. The amount of snow which a given volume of cold running water will melt and carry away is definitely determined; and if we shovel in more than this limit, the surplus simply refuses to melt and run away promptly. Moreover, there is a very considerable volume of permanently solid matter in the snow after it has been shoved about over the city pavement, and when we thrust this into the sewer it tends to clog the flow and interfere with the normal business of the stream—which, of course, is the sanitary flow.

Finally, it turns out that the financial advantage in using the sewer thus to aid in snow removal is pitifully small—sometimes, even a negative quantity. For with removal by truck, the snow does not have to be moved in the street by hand at all; the trucks are everywhere, and the snow is put directly into them from its place on the pavement. But when we come to manhole deposition, we must either employ trucks for the unprofitable small hauls of fifty to a hundred feet, or we must shove the snow along the ground much as the summer street-cleaner shoves the accumulated dust and manure in a big flat long-handled scraper. The picture which we present herewith shows up most admirably all the weak points of this scheme—its sanitary drawbacks as well as its uneconomy of labor; and this sketch interprets admirably the observed fact that it really does cost as much to handle snow this way as to load it right into trucks and haul it off to the river. Then on top of that there is the necessity of cleaning out the sewer after the winter is over, so that the sanitary flow can resume its wonted course.

To meet this suitation, a New York civil engineer, Mr. L. Davidson, comes forward with a suggestion which we diagram in our second cut. He points out that in the metropolis as well as in many others of the larger eastern cities the sewers are getting old, and stand in more or less desperate need of reconstruction. In New York, specifically, much of the sewer mileage is so nearly definitely worn out that means of replacement must be seriously considered in the immediate future. So Mr. Davidson suggests that this necessary reconstruction be made the occasion of a redesigning which shall adapt the sewer better to the purpose of aiding snow removal, while not prejudicing in any way its ability to discharge its regular function.

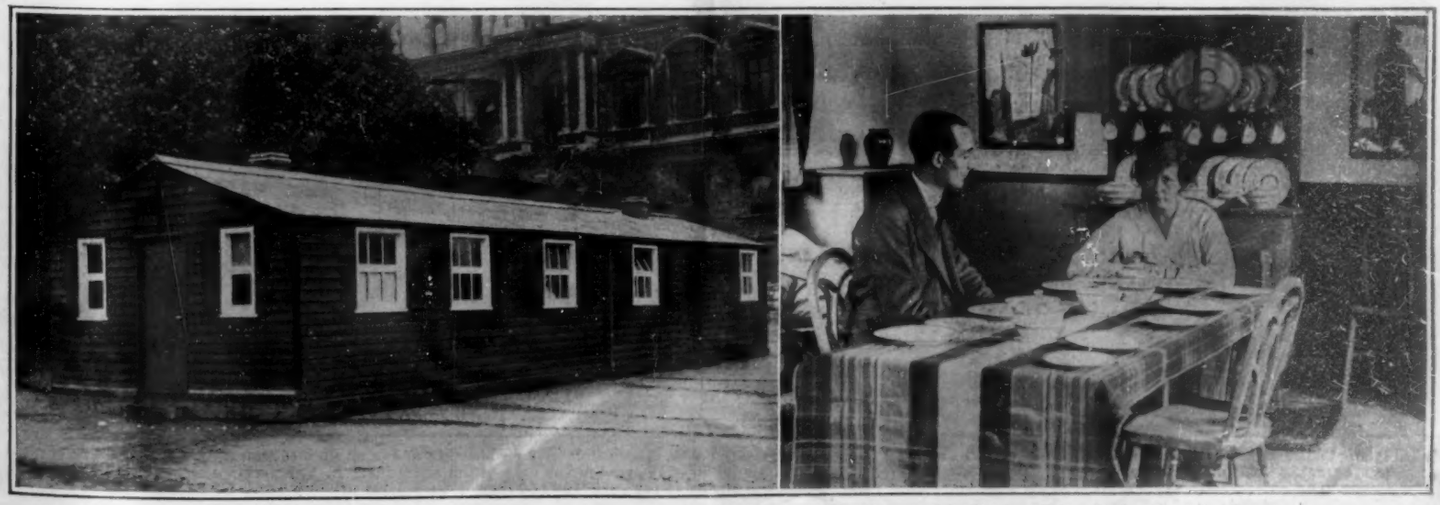
The first feature of Mr. Davidson's design is the elimination of the manhole in favor of a continuous opening down the center of the street. This slot would take the place, not alone of the central manholes, but also of the big corner openings through which the street drainage enters the sewer. In order to make this possible, the street would be "crowned" down toward the center from each side, instead of up, so that everything fluid would gravitate toward the center

(*Continued on page 323*)

Emergency Housing in Britain

HERE in America we are apt to think we have a housing problem—and so we have, in a way. But it is a financial problem only; everybody is able to find a house of some sort to live in, the only trouble is that he has to pay more than he wants to and in many cases more than he can afford. If we seek a place where the housing problem assumes a physical aspect, where there are literally not enough houses to go around, so that large numbers of people do not have any assurance that they will be able to find shelter, we must look to Europe.

In various sections of England, for instance, the housing problem takes this form. In London the situation has become so acute that the city administration has had to take a hand, providing temporary accommodations in the open public spaces for the families that can find no regular housing. Accordingly there have been erected in many of the parks and squares wooden bungalows of the sort illustrated on this page. While capable of being put up with great rapidity, and falling in the category of "portable" houses, these structures are by no means flimsy affairs, and it seems possible to live in them with a good deal of comfort. That they can actually attain something of the home atmosphere is shown by the interior view of one of the London bungalows, occupied by a returned soldier and his bride. Unlike some of the temporary expedients in the housing line, these little dwellings are properly cut up into rooms, and are in fact so designed that they are entirely livable.



Exterior and interior views of one of London's portable bungalows erected by the municipality to relieve the housing situation

Our Technical Achievements in the Great War—Concluding Chapter

The Share of the Various Armies in Bringing About the Final Victory

DURING all the long years of the great war in Europe, and particularly towards its end when the complete overthrow of the enemy was in sight, it was the sincere hope of the military men who were doing the fighting, that the ultimate victory would not be clouded by any fruitless and ill-timed discussions as to "who won the war." Great as was the individual share borne by the various national armies and the strong individual sense by each army of its own vast accomplishment, there was an unwritten agreement, based upon the restraints both of good breeding and good sportsmanship, that no one nation should unduly emphasize its own share in the war to the disparagement of the work done by its allies. Military men realized during the heat of conflict, as they do indeed today, that each army, however great in numbers and equipment, and however distinguished by heroic performances, was, after all, but a single link in a great chain which must never be broken if the enemy were to be held fast and finally brought to terms.

Although the above considerations prevented any invidious comparisons by the men who had done the fighting, there was always a danger that the civilians at home would not be thus restrained. As the event has proved, the politician and the journalist have not been able to resist the temptation to indulge in national exploitation, which has been too often accompanied by most ungenerous depreciation of the work done by other armies of the Allies. The evil of this agitation lies in the fact that it is a most effective means of breaking up the good feeling and sense of brotherhood which has been established among the Entente nations during the war. For this reason, any discussion as to who won the war is hailed with ribald joy by the enemy and by those elements in the various countries, including our own, which are hostile to one or other of the Allied nations.

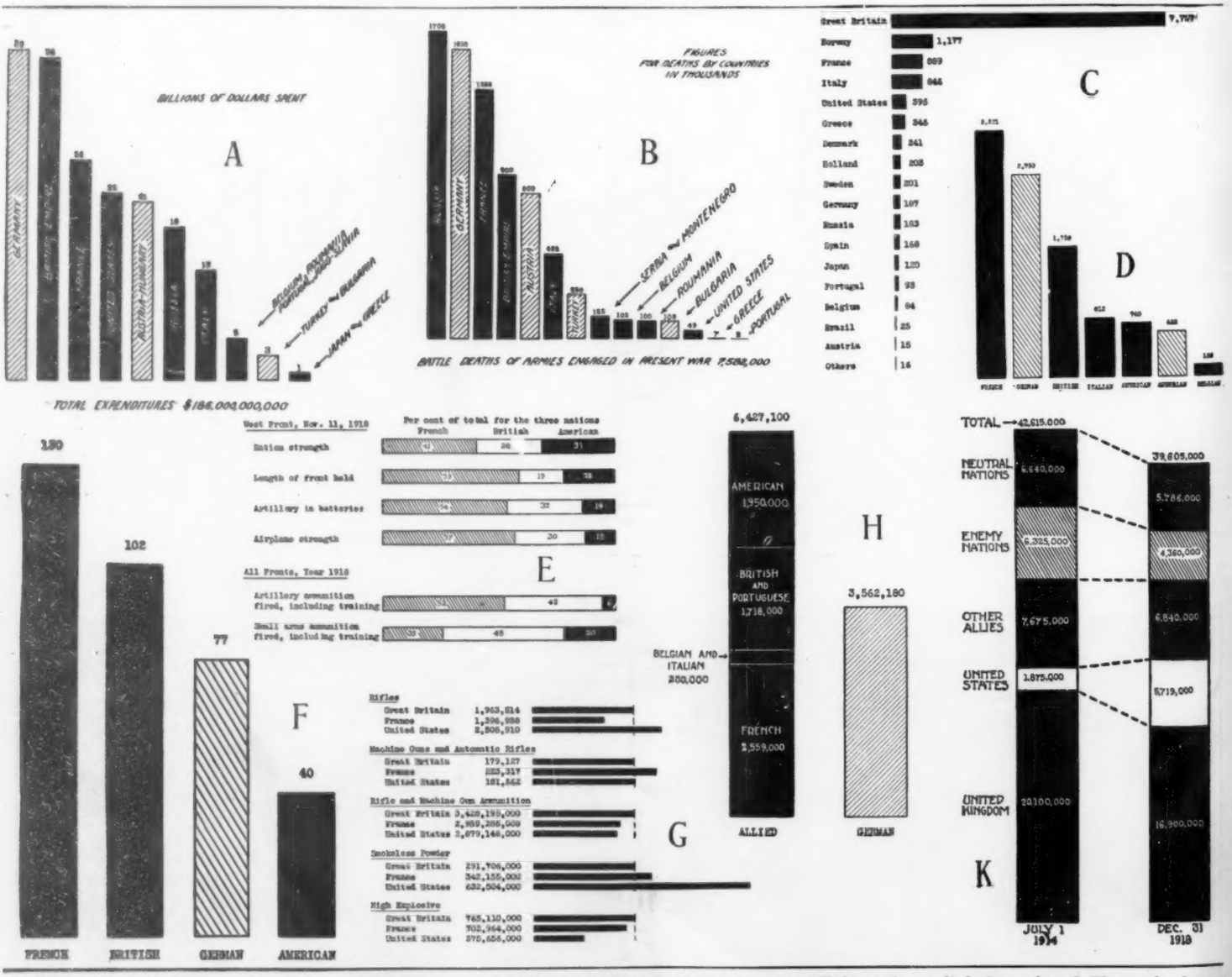
"Who won the war?" The answer is that all the nations won it by a self-sacrificing and steadfast coöperation, the absence of which would have resulted in an overwhelming victory to the enemy.

The concluding chapter of the "Statistical Summary of the War," drawn up by the Chief of Statistics Branch of the general staff under Col. Leonard B. Ayres, consists merely of a set of diagrams as reproduced herewith. Unlike the rest of the report, there is no text accompanying the diagrams. They are left to speak for themselves. They show, as nothing else could, how closely interwoven and mutually interdependent was the work done, both in the factory and in the field, by the army at the front and by the civilian workers at home.

In one table, such as that showing the numbers killed in battle, France, Great Britain and Italy greatly predominate. In another showing contributions in wealth or in equipment, there will be a sharp change in

(*Continued on page 324*)

WITH this, the concluding chapter of the Series, "Our Technical Achievements in the Great War," The Scientific American brings to a close its record, extending over five years, of the scientific aspects of the greatest struggle in all human history. Not the least valuable part of the record is that which has appeared since the signing of the Armistice; for the coming of peace released much valuable data. Henceforth the space devoted to Army and Navy subjects will return to the peace-time scale to which our readers were accustomed before the war.—THE EDITOR.

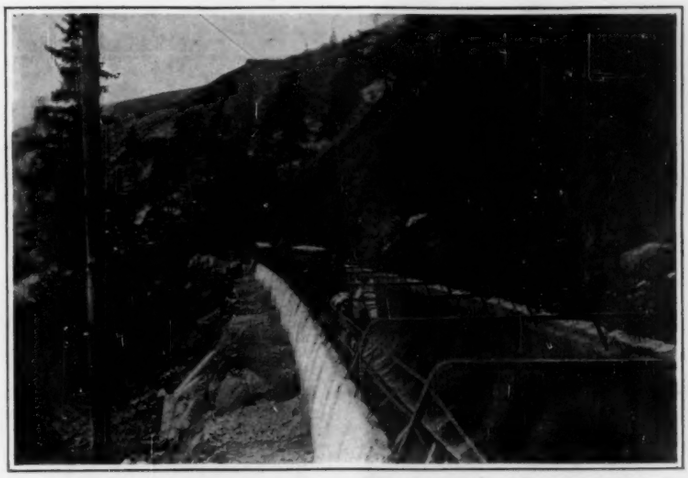


A. Billions of dollars spent by each nation for direct war expenses to the spring of 1919. *B.* Thousands of men killed in action or died of wounds. *C.* Thousands of gross tons merchant shipping lost through acts of war. *D.* Number of battle airplanes in each army at the date of the armistice. *E.* Comparative strength of armies and comparative expenditures of ammunition during 1918. *F.* Battle airplanes per each 100,000 men in each army at armistice. *G.* Production of articles of ordnance during the 19 months of American participation in the war. *H.* Ration strength of the Allied and enemy forces at the armistice. *K.* Seagoing merchant shipping of the world in gross tons, July 1914 and December 1918

Concrete Canal Becomes a Driveway

THE Tieton Irrigation Canal, in the State of Washington, was constructed in 1907-09 by the United States Reclamation Service, and has been carrying irrigation water for the past eight years. The territory which it waters covers 32,000 acres, three quarters of this being in a high state of cultivation, and 8,000 acres having been added to the district by a recent extension. This addition made it necessary to increase the water-carrying capacity of the canal, and the necessary work to this end was completed last fall.

The canal is constructed along a very rough and precipitous canyon wall, and in its approximate nine miles of length it falls 500 feet. As originally built it was circular in form, slightly exceeding the semi-circle; the upper rims were 22 inches above the horizontal diameter of the circle, which was 8 feet 3⅝ inches in length. The concrete sections of the trough were two feet wide and four inches thick, and were tied together across the top of the ditch by 4- x 6-inch reinforced concrete bars.



New top segment of straight wall sections added to the sides of the Tieton Canal to increase its capacity

To enlarge the canal, a new top segment was cast in place on each side, after removing the cross-braces. Satisfactory binding between the old and the new concrete was secured by notching and grooving the top of the old. Then new cross-braces, similar to the old, were added. The concrete of the old bars was broken up and used in the new aggregate, and the steel was salvaged. For simplicity of construction, the added wall-sections were built straight, in line with the tangent to the circle at the old top.

The project was rather exacting in that the work could be carried on only between the first of October and the middle of November, for a period of seven weeks. It was begun in 1916, continued in 1917 and completed last fall. The causes of this short working season were the weather conditions in the canyon for the greater part of the winter, and the necessity for having the canal in uninterrupted service during the agricultural season.

The outstanding problem was the delivery of material to the local working points. Everything had to be hauled by teams from various centers along the river, but the configuration of the canyon is such that delivery to the canal could be made at comparatively few points. There was one section of the ditch a mile and a half long for which there was only a single practicable delivery point. Accordingly it was necessary to employ the canal itself as a highway for further distribution to the workmen.

This was at first attempted by having men to haul small cars and trucks back and forth on the canal bottom. After a few days it became evident that no time would be made in this way, however, so mules were brought to the job, and thereafter the work went along in good shape. The mules hauled good loads in very satisfactory time. At the same time a small stream of water was allowed to flow continually through the canal to furnish water for the boilers and for the concrete mix; this of course materially lightened the task of the mules. Our cover this week shows one of the cars en route through the canal.

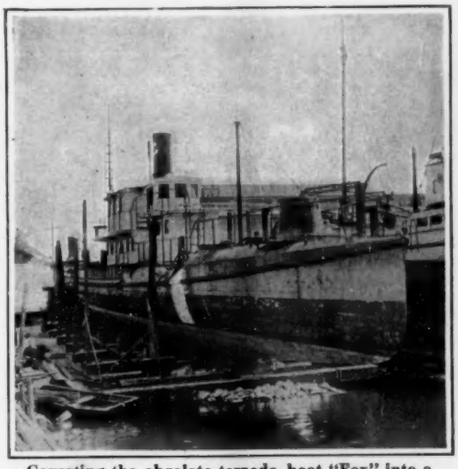
Old Torpedo Boat for Fishing Banks

A NEW experiment, that of converting obsolete naval vessels into ships for practical purposes, is now being conducted in Seattle, Wash., where a fishing corporation has purchased the old torpedo boat "Fox" from the government and is fitting it up as a deep-sea trawler for use in catching halibut on the fishing banks of the Pacific Ocean. The "Fox" was built in 1899 in Portland and is a sister ship of the "Davis" and "Goldsborough." She participated in the Boxer disturbance in China.

The photograph shows the "Fox" on the ways of a Seattle ship-repair plant. She still retains her graceful lines and the sharp bow of a torpedo boat, but a new house and stack are added. Twin-screw propellers are being installed and new engines emplaced and in all respects being properly outfitted for her new sphere of activity.

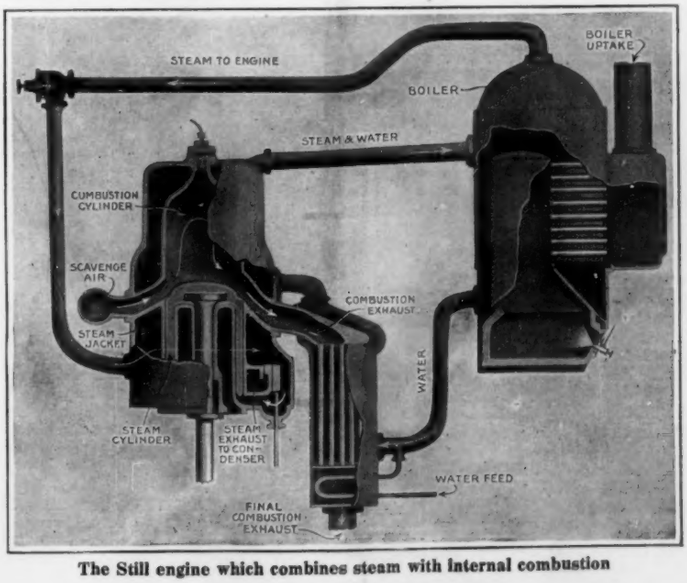
Steam and Internal Combustion Combined

CONSIDERABLE public interest was recently aroused by a paper read before the Royal Society of Arts in London, on a new prime mover of a remarkably high efficiency, invented by William Joseph Still.



Coverting the obsolete torpedo boat "Fox" into a fishing smack

The engine combines the advantages of the steam engine with those of an internal combustion engine, for it uses gases of combustion on one side of the piston and steam on the other.



The Still engine which combines steam with internal combustion

As pointed out by Mr. Frank E. D. Acland, author of the paper, a steam engine exerts powerful starting efforts so that it is particularly adapted for putting trains and other masses into motion. It can operate at any speed from start to its designated maximum. It can develop more than its rated power at reduced speed. It can carry a severe overload for long periods and usually gives ample warning before ceasing to operate. But the heat efficiency of the steam engine is very low. At least 80 per cent of the energy in the fuel supplied to it is lost.

The internal combustion engine, on the other hand, shows a much higher heat efficiency. But it cannot start without the aid of some external source of power. It cannot develop its full power except at full speed, it operates very poorly at low speeds, and it cannot endure overloads for long periods. Furthermore, it may cease to operate without any warning, owing to some small defect. On account of these disadvantages the internal combustion engine has not offered any serious competition to steam in railroad, marine or stationary power plants.

Most of the loss represented by the steam engine occurs in the generation of steam. To be sure, the engine has been developed to a very high degree of efficiency by superheating, compound and condensing, but further developments of efficiency can hardly be expected in any marked degree. The very largest and best steam turbines show an efficiency of only 18.5 per cent of the heat units in the fuel used. On the other hand, gas engines have reached an efficiency of 28 per cent, and the best Diesel engines have shown as high as 36 per cent efficiency.

The internal combustion engine possesses an advantage over the steam engine in the fact that the fuel is introduced and burned in the very cylinder of the engine, but the disadvantage of this system lies in the fact that temperatures are produced that are much higher than those of a boiler furnace, and even higher than the melting point of cast iron, so that a cooling system has to be used to lower this temperature sufficiently to prevent injury to the working parts of the engine. Efforts have been made, from time to time, to utilize the heat in the cooling system of an internal combustion engine and also that of the exhaust gases, but while some heat can be recovered from the exhaust gases, the cooling water in the jacket is ordinarily of too low a temperature to permit of recovering any energy in the form of steam.

Mr. Still, however, has designed an internal combustion engine in which he uses a very thin shell for his cylinder, this shell being reinforced with vertical ribs and the whole being surrounded by a jacket of steel which serves to give adequate strength to the cylinder. On account of the thinness of the wall separating the combustion chamber from the cooling water, there is a far more rapid rediation of heat into the water, with the result that much more heat may be recovered in the cooling system. In fact, the temperature of the cooling water surrounding the combustion chamber is maintained at 350 degrees Fahrenheit. Furthermore, the exhaust gases from the combustion chamber pass through a system of radiating pipes whereby they impart a considerable portion of their heat to the water.

In addition to these means of heating the water, there is an auxiliary steam generator or boiler, which may form an integral part of the engine or may be separated from it, as shown in the diagramatical view herewith. The steam thus produced is introduced under the piston and serves to return the piston after it has been moved downward by the combustion gases.

Of course there is a slide valve, as shown in the drawing, to permit of alternately introducing the steam under the piston and carrying off the exhaust steam to the condenser. By this combination, of steam on one side of the piston and gases of combustion on the opposite side, the Still engine has been able to show an efficiency of 41 per cent. It will be noted that during the compression stroke,

(Continued on page 326)

The Heavens in October 1919

The Comets Discovered by the Rev. Mr. Metcalf

By Professor Henry Norris Russell, Ph.D.

THE most interesting astronomical event which has to be recorded since the last of these articles was written is the discovery of two comets, within two days, by the same observer—and that as an incident of a summer vacation. The astronomer who is responsible for this unusual feat is the Rev. J. H. Metcalf, a Massachusetts clergyman who, in the intervals of his spiritual duties, devotes himself to a study of the material heavens with a knowledge and skill that entitle him to a prominent place among American observers. Not content with making telescopes—grinding and polishing the lenses, after calculating their dimensions and curvatures by most laborious and involved reckoning—he sets his instruments up and makes discoveries with them. A month ago he was in camp on South Hero Island in Lake Champlain, and evidently he had one of his smaller telescopes with him (his masterpieces of construction are far too big to be portable), for on August 20th, at midnight, he discovered a comet in the constellation Pegasus, in 22h 48m R. A. and 25° north declination. Not quite forty-eight hours later his searchings were rewarded with a second comet—this time in Boötes, in 14h 5m R. A. and 27° north, not far from Arcturus. The latter comet was independently discovered by Borelly at Marseilles on the following night.

A Close Cometary Passage

The first of these two comets appeared in the telescope as a diffuse mass of light, about equal in brightness to an eighth-magnitude star, but with no definite nucleus. It showed a rapid northerly motion, which gave good reason to suspect that it was pretty near the earth, and this suspicion was confirmed as soon as its orbit had been calculated.

The orbit of the comet, and its motions and relations to the earth and sun, are shown in the diagram. At the time of discovery it was nearly 120 million miles from the sun, but only 40 million from the earth. At first it approached both, and on September 8th it passed very near the earth, though hardly as close as the diagram would make it appear, for the comet's orbit was well above the plane of the ecliptic, a state of affairs which of course cannot be indicated in the figure; so that the least distance of the two bodies was a little more than 30 million miles. On October 1st the comet will be about 60 million miles from the sun and 50 million from the earth, while at perihelion, on October 16th, it will be 80 million miles from the earth and 45 million from the sun. After this its rapid motion carries it swiftly away and at the end of the month it will be nearly 120 million miles from us, and rapidly fading.

Its apparent path in the sky has so far led from Pegasus northward, with accelerating motion, into Cepheus and Ursa Minor, passing within some twelve degrees of the Pole, and then down into Ursa Major, whence it will move further southward into the western part of Leo. At the time these words are written it is about two degrees north of *Epsilon Ursae Majoris*, and is easily visible with the naked eye, while it is conspicuous in a field glass. This indicates that, as is the custom with most comets, it is increasing rapidly in intense brightness as it approaches perihelion and that it will be a fairly brilliant object in the first half of October, probably of the second or third magnitude. During this interval it will be best visible in the morning, rising three hours or so before the sun. In the absence of a detailed ephemeris for these future dates, exact predictions of its position cannot be given, and indeed it would not be worth while to calculate them from the rough orbit which is now available; but it is safe to say that the comet will not be far from a line drawn from *Epsilon Ursae Majoris* to *Beta Leonis*, and will be nearer the latter star. How conspicuous it will be depends upon the extent to which it develops a tail. It has not yet begun to do this perceptibly, but a nearer approach to the sun may start one growing.

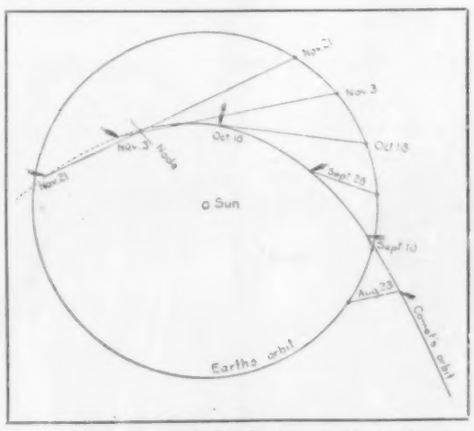
Metcalf's second comet differed at first sight from the others in several respects. It showed a well-defined nucleus, and was moving slowly southward, at the rate of a little over half a degree per day. No elements of the orbit have yet come to hand in this rather out of the way place, and from the data already available it is hardly possible to say more than that it looks as though the comet were probably at a considerable distance, in which case it would be a fairly big one, as it is described as "visible in a field glass." Further data should soon be available.

At 11 o'clock: Oct. 7.
At 10½ o'clock: Oct. 14.
At 10 o'clock: Oct. 22.
At 9½ o'clock: October 30.
At 9 o'clock: Nov. 7.
At 8½ o'clock: Nov. 16.
At 8 o'clock: Nov. 23.

NIGHT SKY: OCTOBER AND NOVEMBER

The Heavens

As our map shows, the great square of Pegasus is almost overhead. Towards the northeast stretches the line of Andromeda, beyond which is Perseus, then Auriga lower down. Aries and Taurus are well up in the east, and Orion is rising. Eridanus and Cetus fill the dull southeastern sky, Aquarius and Capricornus the equally unpromising region in the southwest, which however is brightened up by Fomalhaut. Cygnus, Lyra and Aquila form a brilliant group in the west, while in the north Cepheus and Cassiopeia are above the Pole, Draco and Ursa Minor below it, and Ursa Major still lower, on the horizon.



The path of the comet showing its relation to the sun and earth during its period of visibility

The Planets

Mercury is an evening star this month, and is best visible toward its end. As he sets only fifty minutes later than the sun and is but eight degrees south of him, he will be very hard to see.

Venus is a morning star, and is exceedingly conspicuous, reaching her greatest brilliancy on the 20th, when she rises at 3 A. M. by ordinary mean time, or 4 A. M. by the artificial time which with this month disappears from American annals.

Mars too is a morning star in Leo and rises at 2:10 A. M. (mean time) in the middle of the month. Jupiter is in Cancer, some 20° west of Mars, and rises about an hour and a half earlier. Saturn too is in this part of the sky. On the 24th he is in conjunction with Mars. At Greenwich noon, or 7 A. M. by Eastern Standard Time, the planets are only five minutes of arc apart, and they will form a very beautiful pair in the sky that morning before sunrise, being barely separable to the naked eye.

Uranus is in Aquarius, and comes to the meridian at about 8 P. M. Neptune is in Cancer, not far from Jupiter, and is observable before daybreak.

The moon is in her first quarter at 4 A. M. on the 2nd, full at 9 A. M. on the 9th, in her last quarter at midnight on the 15th, new at 5 P. M. on the 23rd, and returns to the first quarter at 9 P. M. on the 31st (all these hours are given in the ordinary mean Eastern Standard Time which will actually prevail on the date last named). She is nearest the earth on the 10th and farthest away on the 26th. While completing her course around the skies, she passes near Uranus on the 6th, Neptune and Jupiter on the 17th, Mars and Saturn on the 19th, Venus on the morning of the 20th, and Mercury on the 25th. The conjunction with Venus is closer than the others, but still pretty wide—about three degrees.

September 13, 1919. Lake Minnewaska, N. Y.

Addendum

Later information, just received, is to the effect that Metcalf's first comet has been recognized by the computers at the University of California as identical with the fifth comet of the year 1847, which was discovered at that time by Brorsen. The observations of the earlier apparitions indicated definitely that this was a periodic comet, with a time of revolution of about 75 years. The actual interval of 72 years agrees with this, well within the limits of error.

Elements of Metcalf's second comet have also come to hand, and confirm the suspicion previously expressed concerning its great distance. Two preliminary orbits—computed at the Naval Observatory and the University of California—differ considerably, as is usually the case with a distant and slowly moving body. The perihelion distance is great—125 million miles according to one orbit and nearly 150 million according to the other; and the comet will not reach perihelion until the middle of December. The orbit plane is inclined 47° to the ecliptic and the descending node is close to the perihelion. At present the comet is some 140 million miles from the sun and nearly 200 million from the earth (or still further if the larger perihelion distance is accepted). During the next six months the earth and the comet will swing half way round the sun but on opposite sides of it, so that the comet will never come within much less than 200 million miles of us, and will be inconspicuous—though it will probably be telescopically visible in the southern hemisphere for the better part of a year.

On October 1st it will be roughly in 15h 20m R. A. and 9° north declination, but this estimate, which is derived by extrapolation from the published ephemeris, is very rough. It should be an easy telescopic object, and visible in a good field glass, but not with the naked eye.

September 15, 1919.

Asbestos Mines of Quebec

How Nature Put the Mineral Fiber in the Rock, and How Man Gets It Out

By W. F. Sutherland

THE well known story of the table cloth cast by Charlemange into the fire, the use by the Romans of asbestos for cremation robes and the derivation of the word asbestos from the Greek, all attest to early knowledge of a material now extremely useful in the industrial arts.

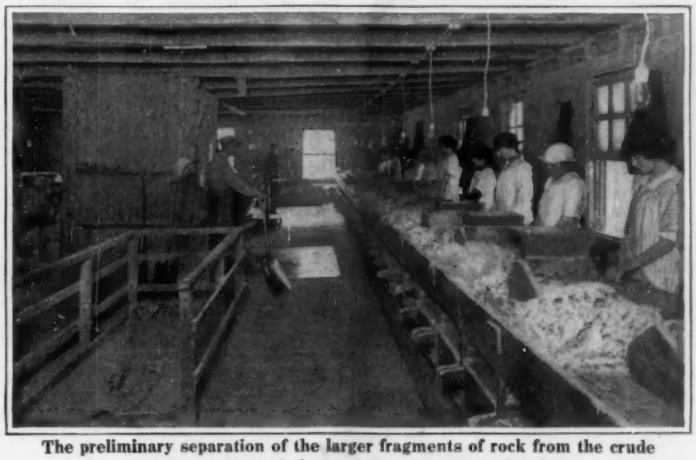
The wonder caused by this behavior of a fabric, in appearance not unlike the textile materials spun by man from natural animal or vegetable products, is not unusual. Nor has it been many years, so the story goes, since a supposedly respectable and well behaved lumberman was run out of a Canadian lumber camp for washing his socks in the stove instead of by more conventional methods, this procedure savoring strongly of witchcraft in the minds of his fellow lumber jacks.

The same qualities which made asbestos a curiosity in ancient times are of the greatest use in present day industry. A fire-resistant fiber which can be spun and woven into articles of use where high temperatures are required must be obviously of high value. Asbestos resists temperatures of from 2,000 to 3,000 degree Fahrenheit and this behavior is all the more remarkable when it is known that it contains as high as 14 per cent of combined water by weight. This combined water seems to have a great effect on the flexibility and softness of the fiber; very silky fiber having over 14 per cent while a harsh brittle fiber will show only about 11 per cent.

At the present time the Province of Quebec is the world's chief source of asbestos, the production in other countries being comparatively small. Russia is the chief producer outside Canada, the asbestos being mined in the Ural district. Before the present trouble in Russia most of the Russian asbestos was either used locally or exported to Germany, a little reaching the United States.

Geographically asbestos is a widely distributed mineral, although many of the deposits are of little value commercially. The United States has many deposits, Newfoundland has large deposits of good quality and Italy was formerly a large producer. China, Siberia, Australia, New Zealand and South Africa have also deposits which may be of use in the future. The South African fiber is of very good quality and the mines are being rapidly developed.

Two varieties of asbestos are met, amphibole and chrysotile. The amphibole or hornblende asbestos is much inferior to the chrysotile, having none of the fineness of fiber, the tensile strength, the elasticity nor the flexibility of the chrysotile. It also differs in chemical composition from the chrysotile in having lime associated with its magnesia while the chrysotile is a hydrated silicate of magnesia. The Canadian deposits of asbestos are of the variety known as chrysotile and it occurs only in a serpentine rock to which it is essentially similar in chemical composition. Serpentine in itself is very similar to peridote, a rock in which it is usually found, differing only in being hydrated.



The preliminary separation of the larger fragments of rock from the crude asbestos is carried out, as here shown, by hand

In the cooling of the peridote from the igneous state it is surmised that cracks were formed and the hydrating action being carried on by heated water changed the rock into serpentine and at the same time widened the fissures. The water carried some of the serpentine into solution and on crystallizing out, the dissolved mineral formed threadlike crystals usually building up from opposite walls and meeting or forcing past each other at the center.

Two varieties of chrysotile asbestos are found in Quebec, the Thetford or cross-fiber type and the Broughton or slip-fiber type, named after the townships in which they predominate. The Thetford or cross-fiber type occurs in thin irregular veins traversing the serpentine rock. These veins are seldom more than two or three inches thick although in places they may attain five or six inches. The fibers being arranged perpendicularly to the walls of the vein are never very long, in no case exceeding the width of the vein and in many cases shorter due to the parting in the center.

The asbestos found in Broughton township while of the same chemical composition has a different physical appearance. It consists almost entirely of slip fiber or short fibers overlapping each other and which lie along the faces of numerous fractures. In places almost the entire rock seems to be fibrous and the only distinction between the asbestos recovered and the rock on the dump is in the length of fiber in each. Unlike ordinary fibers there seems to be no limit to the subdivision of the asbestos fiber. In an investigation carried on by A. Kingsbury with the aid of a microscope, at a magnification of 90 diameters the subdivision of the fibers appeared to be unlimited. The bundles broke up and branched off into other still finer collections of lines. At 900 diameters, fibers appeared which were barely discernible and which were estimated to be five one-millionths of an inch

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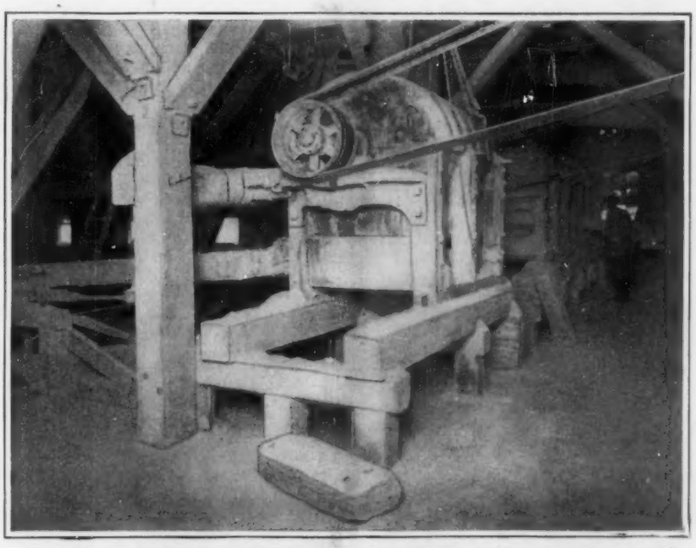
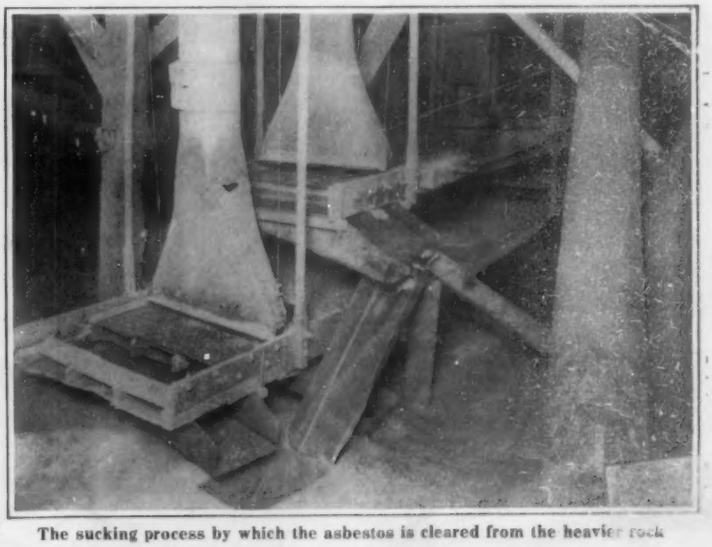


The crushers which reduce the asbestos to a condition making screening possible

The final sifting process in the separation of the asbestos from the barren rock



The sucking process by which the asbestos is cleared from the heavier rock

This horse has learned to turn on the water and help himself to a drink when thirsty

A Striking Example of Equine Intelligence

EVERY now and then we come across an animal which has acquired certain accomplishments that indicate an unusual degree of intelligence. It is difficult to account for his feats on the ground of instinct; instead they seem to indicate that the animal is possessed of real reasoning powers. To be sure we have our trick animals who are trained to go through very remarkable performances, but in these feats they do not necessarily demonstrate any reasoning powers of their own. Their performances are merely reactions to certain stimuli resulting from long and patient work upon the part of their trainers. But when an animal learns to perform a feat as a result of his own powers of observation and without human aid the case is truly remarkable.

From New Zealand come the three photographs shown on this page, of a horse that has learned to turn the spigot of the water supply line and serve himself to a drink whenever he is thirsty. This, we are told, he has learned to do without any training whatsoever. He watched the performance of turning the spigot and reasoned out the connection between the turning of the valve and the appearance of the stream of water. Then he tried the valve handle himself and found that he could do the trick. Being of an impulsive and impatient nature he does not wait for a bucketful of water before starting to drink. Instead, he places his mouth over the stream and drinks right from the spigot. Whether he turns the water off after he is through we are not informed, but we should hardly suspect him of more consideration in this respect than is shown by some human animals.

Hand-Sawed Planks Where Time and Labor Are Cheap

TO our American sense of efficiency, it seems nothing short of criminal waste to see two men sawing planks by hand out of solid timber. Yet that is precisely what is being done in the accompanying view, taken in the Near East, where time is plentiful and labor even more so.

This picture shows an ingenious form of saw the blade of which can be shifted as may be found necessary for sawing the planks. The sides of the saw frame act as guides, so as to make the saw cut straight. While this method may be ingenious, it is crude in the extreme compared with the American way of cutting planks with a gang saw at the saw mill.

Free Education from the Film

THE Bureau of Commercial Economics, an altruistic organization exhibiting educational films all over the world, has started a nation-wide campaign to get free motion picture theaters into factories, department stores, mining towns, country crossroad centers, lumber camps—every place, in fact, where there are workers.

The bureau has the largest educational motion picture library in the world—21,000,000 feet of film on almost every conceivable subject, such as government, economics, industry, history, travel, nature, science, health, commerce, agriculture. All these pictures will be loaned without charge to those who will exhibit them free to audiences.

In order that thousands instead of hundreds of business men and organizations may become borrowers of these films, the bureau is sending out questionaires, the answering of which will enable the bureau's engineer to advise as to the equipment most suitable under the circumstances, how best to adapt the workshop, church, hall or factory lunchroom for motion picture exhibitions, and any other questions the individual case requires.

In addition the bureau is sending eight traveling motion-picture theaters—specially built auto trucks—all over the country to arouse persons and organizations, particularly employers, as to the possibilities of educational pictures. These trucks carry a projection machine, an electricity generating plant and portable screen. Thus they are able to show pictures at an isolated western ranch center as well as in a city.

In New England one truck is showing samples of the films that employers could exhibit in a darkened workshop at noon, or at night when the wives and kiddies may see, too—if employers would spend $200 or $300 for equipment.

If the masses of Russia had been as educated as the American people, Bolshevism never would have raised its venomous head. There are thousands of workmen in this country, too, who really believe that the shortest cut to a fatter pay envelope is through the destruction of the present employers. The professional agitators have told them so, and nobody in particular has ever told them differently. Well, the 21,000,000 feet of educational film are ready to do this.

The bureau has films taken in Russia under the Bolsheviki. These and pictures of life in America form an elegant contrast. Sitting in the silence of an improvised theater in a work-shop, the employes can take their pick—the American plan or the Soviet plan.

One big reason for the social unrest is the narrowness of the lives of many of the workers. Educational pictures will enable them to step out of the rut of a life bounded by factory, home and corner coffee club, and begin to live in the wide world. An employe's interest in his work would be increased if he could see motion pictures showing how the men on the other end of the job work getting the raw product to the factory door, and other pictures showing the ultimate uses of the finished product, which he turns out, and the various processes to which it may be subjected after it leaves his hands.

Industrial films are used to show one part of the country how the other half works and lives. The bureau is eager for more of these industrial pictures, and wishes manufacturers who have had films made of their own plants would submit them.

The bureau believes employers would find it a good plan to let employes feel that the picture show belongs to them. The employer could offer to provide space, and equipment if employes would run the show—select programs from the bureau's catalogue, attend to the details of ordering the pictures, etc. Thus a point of coöperation would be established between employer and employes which would be worth many times the cost of providing the "theater."

The bureau, making no profits on its films, is supported by endowment, annuity and voluntary subscription. The United States Government and principal foreign governments are coöperating with it. Its films are now teaching mothers of India how to stop their babies from dying. The bureau's films go by dog sled to the tuberculosis-stricken Esquimo, by camels to the dwellers of African deserts, and by llamas over the Andes to the Inca Indians.

Sawing timber into planks by an antiquated method

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

The street sign that is always visible

A Day and Night Street Indicator

A CALIFORNIA man has recently invented a device embodying a new idea in street marking. This indicator consists of a heavy cast iron frame with insets for heavy plate glass. The plate glass is colored red and the names of the intersecting streets are lettered in white. The whole frame is bolted to a concrete block into which a conduit is fitted for receiving the wiring. At night the lamp inside the frame is lighted and the red glare may be seen from a great distance. The street names may be read from a moving automobile at the distance of 100 feet.

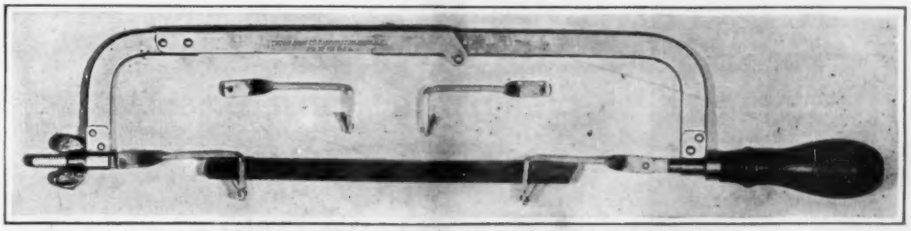
The indicator takes up little room, being 17 inches square and rising only 4½ inches above the level of the street, and is no obstruction to traffic. Besides directing pedestrians and tourists these indicators aid in enforcing rules as to cutting corners.—*A. P. Child.*

Extending the Life of the Hack-Saw Blade

CONVENTIONAL hack-saws are open to the complaint that the blade has to fit the handle or they cannot be used. The only way in which it has ever seemed possible to realize the universal hack-saw, in which a blade picked up anywhere will fit a handle picked up anywhere else, was by putting out of business all the tool makers except one, so far as the hack-saw trade was concerned.

The little invention which we illustrate in the middle of this page was not got up with the primary intent of achieving the universal hack-saw, but that appears to be one of the results which would follow its general use. Its primary intent was to make it possible to use a blade off the end of which a piece had been broken. Always before, this by no means uncommon shop casualty has meant the discarding of the offending blade, and hence the waste of a goodly amount of material which in itself was quite capable of giving further service.

This waste is now eliminated by a simple little part which in effect extends the arm of the saw so that it will be able still to grip the broken end of the blade. Our photograph shows two of these parts in action—one at each end of the saw—and also two standing alone, above the blade, so that their construction will better appear. The downward-bent segment, of course, is slotted to let the blade pass through, and the little metal flap, which hangs loosely against this segment catches in one of the teeth of the blade. This holds the thin blade securely against a pull in either direction; so whether we have a blade that has been broken off, or one designed for a shorter bridge than that afforded by our handle, we can hold it rigidly and saw with it.



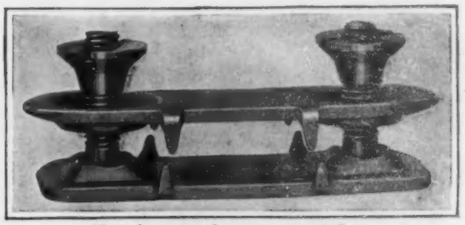
The hack-saw attachment that takes hold of a blade any length

A High Duty Belt Fastener

THE tendency toward increasing thickness in conveyor belts has demanded a new type of heavy fastener; for a belt is only as strong as its weakest point. The device illustrated was got up to meet this need; it is pointed out that it is simple to apply; it takes only a reasonable time in proportion to the size of the belt, while the strength of the joint makes its modest cost a desirable insurance on the cost of the belt. It is made in sizes proportioned to the thickness of the belt and the requirements of the service. It gives a joint of exceptionally high tensile strength, combined with the essential features of smoothness on both sides of the running surface, and an evenly balanced joint.

The new fastener embodies a new application of the compression principle as applied to belt fasteners. It consists of two rectangular steel plates, which clamp on either side of the belt and are connected by nuts passing through the belt. The top plate has two round holes which are countersunk to hold the specially cone-shaped nuts, while the bottom plate has two special square seats which fit around the square heads of the bolts. The new fastener was developed in Chicago.—*F. C. Perkins.*

Gathering walnuts without stooping



New fastener for conveyor belts

The Mechanical Walnut Picker

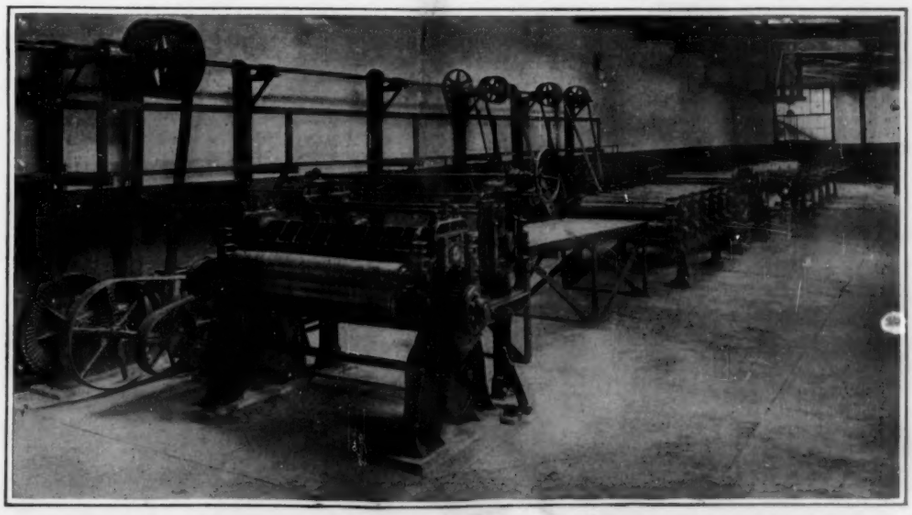
WALNUT growers in southern California who have for long years bent their backs in an effort to harvest their crops are rejoicing over the fact that J. F. Franke of Santa Anna, Cal., has invented and patented a walnut picker.

His invention is nothing more than a galvanized iron funnel which admits the walnuts at the bottom instead of at the top. At fixed distances along the four sides of the funnel are four pieces of spring wire. At the base of the funnel they curve inward to the extent of a single loop. The opening in the funnel bottom is about three inches across, and the four loops of wire close it up until an opening about one inch across is left between them.

The walnut picker places the funnel opening over the walnut on the ground and gives a quick shove to the long handle, which is cut off by the top line of our picture. This causes the springy loops to press down upon the rounded sides of the walnuts, and the loops spring back, admitting the walnut and at the same time contracting to hold it from falling out. When the funnel has been picked full in this manner the picker empties the nuts into a bucket by tilting the funnel to one side.

The picking device has been tested by many walnut growers and most of them express the opinion that they can pick walnuts faster by using it, and all of them admit that it eliminates the backache which has long attended walnut picking, and at the same time makes a great saving in the matter of clothes.

The California walnut harvest this year is the largest in the history of the industry. It is estimated at 48,000,000 pounds worth somewhere near $15,000,000 and this production will be taken from 75,000 acres of bearing groves. This showing is largely due to coöperation.—*H. J. Wood.*



Machinery for making wall board

Unique Wall Board Machine

THE accompanying illustration shows a novel wall-board machine, developed at East Downingtown, Pa., ready for operation. This machine was designed to produce wall board of three, four, five or more sheets. The paste and squeeze rolls are arranged with levers and weights for applying pressure. The cutter is of novel design and will cut board of more than quarter-inch thickness, the edges being clean cut and perpendicular to face of board. It is not necessary to have any sag in the board between squeeze rolls and the cutter; the latter is arranged to cut at the speed of the paper and to cut sheets from three feet to twelve feet long or longer. The drive is on the rear

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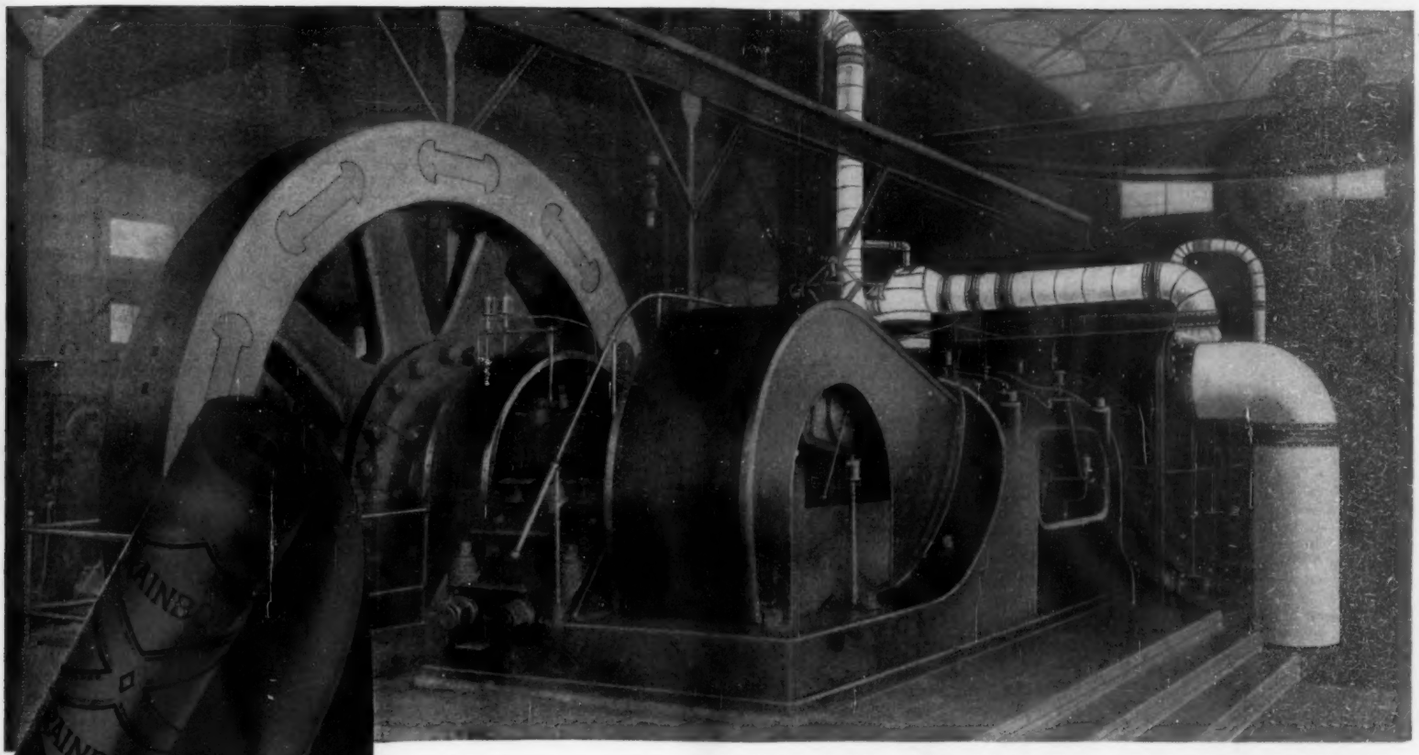


Rainbow! The standard sheet packing of the world

Over 35 million pounds have been used in the past 30 years. It has never failed where the mechanical conditions are correct and the steam temperatures 370 degrees and under.

Rainbow is as reliable as the metal parts of the equipment. This insurance against costly blow outs makes it the cheapest packing from a purchasing and operating point of view.

All Rainbow packing is red but all red packings are not Rainbow. To avoid trouble be sure you receive genuine Rainbow on your orders.

United States Rubber Company

UNITED STATES RUBBER COMPANY
US
RUBBER SYSTEM
AND ASSOCIATED COMPANIES

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

AERIAL BOMB.—J. J. McINTYRE, 91 St. Marks Ave., Brooklyn, N. Y. The object of this invention is to provide an aerial bomb intended to be dropped from an airplane, dirigible or other aircraft, and arranged to insure a positive explosion at the expiration of a predetermined period of time. Another object is to insure an explosion in case the time controlled firing device fails, the bomb then exploding on striking an object. Another object is to enable the user to quickly set the bomb to explode after a predetermined lapse of time.

Pertaining to Apparel

GARMENT SUPPORTER.—T. L. CAUDLE, Wadesboro, N. C. This invention is designed more particularly for use in supporting trousers. An object is to provide a device by the use of which suspenders may be dispensed with entirely, and a belt may be worn for appearance only. Another object is to provide a device which comprises a flexible body having wings insertible between the facing band and cloth of the trousers at the waistline, and a pendent member having a loop which is adapted to be hooked over a hook detachably supported on the shirt of the wearer.

Of General Interest

SUCTION FLY CATCHER.—H. PAKEMAN, 184 Wheeler St., Akron, Ohio. The invention particularly relates to an electrically operated fly catcher in which an air current causes the entrapment of the flies. The device is small, simple and readily mobile, including a casing having an intake and outlet channels, and is provided with suitable bait holding means for the attraction of the flies.

OIL WELL PUMP SHOE.—E. BOWERY, Box 331, Oil Center, Cal. The object of the invention is to provide a shoe wherein the standing valve seat is removable from the shoe without disturbing the shoe. The device comprises upper and lower sections having threaded engagement with each other, and a valve seat detachably connected with the upper section, the lower having an annular stop.

GEM SETTING.—M. BAUMAN, 170 Broadway, New York, N. Y. This invention relates to gem settings of jewelry, and more particularly is intended for embodiment in finger rings. An important object is to provide a setting to firmly hold the gem and at the same time to have the effect of increasing the apparent spread of the gem beyond the actual spread thereof.

RULING ATTACHMENT FOR TRIANGLES.—S. DI MAIO, 209 E. 66th St., New York, N. Y. The object of this invention is to provide a ruling attachment for triangles arranged to enable the user to readily and accurately draw parallel lines especially section lines. Another object is to permit the user to adjust the ruling attachment for drawing parallel lines spaced varying distances apart, and to provide an extension for the triangle.

CONDUIT.—W. B. GRAY, 1327 S. 22d St., Louisville, Ky. This invention has for its object to provide conduits for supporting and insulating heating pipes liable to expansion and contraction and in which the pipes are laid wherein anchored supports are provided for the pipes, and a further object is to provide a form of anchoring in connection with the conduit sections, which anchoring means may be machine molded, when the conduits are formed.

ELASTIC FABRIC.—C. ADAMS, 87 High St., East Rutherford, N. J. The invention relates to textile fabrics, its object is to provide an elastic fabric capable of expansion and contraction lengthwise without the use of interwoven elastic bands, and which is exceedingly serviceable when manufactured into sweaters, petticoats, or other garments, surgical bandages and other devices. Another object is to render the clothing made of this fabric, warm, comfortable, and capable of yielding with the motions of the body at the same time snug fitting.

METHOD AND APPARATUS FOR CASING WELLS.—C. C. POLYSU, care Hotel Bellvein, Ave de l'Opera, Paris, France. This invention is characterized by the fact that the casing is built as the boring proceeds, the casing being built up from the lower end. An object is to provide a mold which follows the boring tool and to which cement may be supplied to mold the casing continuously as the depth of the well increases.

WORKMAN'S COLLAPSIBLE TRESTLE, OR TABLE.—A. LEONARD, Box 224, Carbondale, Pa. The invention relates to a foldable trestle adapted to be used by paper hangers painters, carpenters and the like. A specific object is the provision of a trestle body which has simple and effective means for detachably fastening legs thereto, the means also serving as devices for holding the legs when the trestle is packed for shipment or for holding the leg members in position to form braces or arms in certain uses for the trestle body.

EYEGLASS MOUNTING.—O. D. LADD, 5 White St., Danbury, Conn. This invention relates more particularly to a construction involved in the connection of the finger piece lever with the bridge, of which are known as nose piece glasses, the object being the provision of an arrangement which will materially increase the bearing of these parts, reduce wear and permit of more ready and quick repair than is usual.

HAT CHECK AND HOLDER THEREFOR.—R. C. LEITCH, 2010 E. 36th St., Kansas City, Mo. This invention relates to hat checks and holders therefor, of the character used by railway conductors for indicating the destination of passengers after the taking of the tickets, wherein a holder is provided adapted to be permanently attached at each seat of the car, and a series of checks, the holder and the checks having interchanging and interlocking means for holding the checks on the holder.

SHIPPING CASE.—G. T. KENYON, Box 683, So. Brownsville, Pa. The object of this invention is to provide a case formed of metal and consisting of walls detachably connected to permit the case

PERSPECTIVE VIEW OF A CASE SET UP

to be disassembled when it is empty, to be returned in knock-down condition, or to be stored. The case may be assembled by the most unskilled laborer. The sections are made with tongues which form a bead or bearing at the edges, and the edges are secured by rods.

PAPER-ROLL AND HOLDER THEREFOR.—R. M. MACCORMAC, 71 St., and Holmes, Kansas City, Mo. The invention is intended more particularly for a toilet fixture and paper roll although capable of other uses. Among the objects are to provide a combination fixture and paper roll, that when properly coordinated, the roll becomes automatically locked by the locked engagement of fixture elements within the roll, and remains so until the paper has been nearly used up, thereby preventing theft of the roll of paper.

POTATO PEELER.—H. LEE, Cambridge, Iowa. The object of this invention is to provide a device which may be secured to the hand of the user and by means of which a potato may be easily peeled or scraped, and the eyes gouged out, without changing the position of the knife on the hand. The entire scraper and gouge are formed from a single sheet of material, and the blades may be suitably tempered.

TROLLING SPOON.—J. A. SEBENIUS, 339 9th St., Bremerton, Wash. The invention has for its object to provide a spoon which will, when trailed through the water be caused to move in a zigzag fashion, both the body and tail being concavo-convex, and the convex and concave surfaces of the tail being oppositely arranged to those of the body will cause the spoon to bilt from side to side, but it will be prevented from completely turning over.

CAMERA.—F. E. RUSSELL, Batavia, N. Y. The object of the invention is to provide mechanism in connection with cameras of every character for permitting data concerning an exposure to be printed upon the film, wherein means is provided for receiving such data, and for permitting the said means to be placed in position to print upon the film, and other means is provided for admitting light to the portion of the film engaged thereby to print the same.

DISPLAY CARD HOLDER.—C. M. SUCK, Salem, W. Va. The invention has for its object to provide a simple inexpensive device for holding cards and the like in store windows. The device comprises a base formed as a plate having stamped from opposite sides of its center tongues bent to extend upwardly at right angles adapted to grippingly engage an article.

EGG CANDLER.—J. R. GRANT, 208 N. Wiles St., Chicago, Ill. The object of the invention is to provide a device by which eggs may be graded and simultaneously candled without the use of a dark room, wherein a hood and a light chamber are provided, there being between the hood and light chamber an opening for receiving the small end of the egg, the hood having an inspection opening for permitting the egg to be seen while it is illuminated.

SAFETY PIN.—J. H. RICHARDSON, 48 Magnolia Ave., Long Beach, Cal. The invention has for its object to provide a pin wherein means is provided for locking the pin to the shield or clasp when the pin is closed, this is accomplished by the use of an upstanding tongue midway between the side walls of the shield, adapted to extend through a slot near the point of the pin, to prevent displacement from the shield by strain upon the pin.

CARD FOR INDEXING.—J. A. BEST, 25 Broad St., New York, N. Y. Among the objects of this invention are to provide an index card having means whereby to hold a series of cards as a series and independent of other series, and in nonalined relation so that the edges of the several cards of the series will be offset with respect to one another, thus providing for the viewing of portions of all of the series of cards so held, at one and the same time. The card is so constructed as to be reversible.

FISH NET.—F. W. ARNOLD, 915 Wheeling, Ave., Cambridge, Ohio. The object of the invention is to provide a simple net of the dip type which when not in use will fold into small compass, and when in use will prevent the escape of the fish. In operation the net is lowered to the bed of the stream, at the proper time, the first movement of raising will extend the sides, and a pen will thus be formed to prevent the fish from escaping.

IRON STAND.—D. OSBRY, 16 W. 33d St., New York, N. Y. The invention relates to an iron stand which will render it impossible for the clothes operated on, or the hands of the operator, to become burned by coming in contact with the exterior surface thereof, even though a very hot iron is supported thereon. A further object is the provision of a stand which will include heat insulating structure, which is accomplished by permitting a free circulation of air through its parts.

ORE SEPARATOR.—O. HAWKINS, Globet, Ariz. This invention relates generally to means for separating or classifying material according to various sizes, more particularly for use in the milling and concentrating of mineral ores. Another object is to provide a method in which the crushed or ground ore is fed to a screen member with water or other liquid the under-sized material and liquid passing through the screen, the oversized being retained above it.

Hardware and Tools

TIP ATTACHING IMPLEMENT.—A. YOUDELMAN, 2257 Third Ave., New York. The object of this invention is to provide an implement or hand tool especially designed for attaching

SECTIONAL SIDE ELEVATION OF THE DEVICE

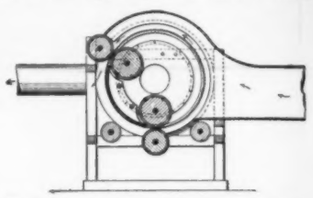
metallic tips to the ends of strings such as are used for lacing shoes, corsets, and the like, and arranged to enable the user to readily replace a worn or broken tip. Another object is to enable the user to manipulate the tool without requiring undue physical exertion.

ANGULAR SOCKET WRENCH.—G. R. FULLENWIDER, Fairfield, Mont. The object of the invention is to provide an efficient tool of this nature, which will be compact, and which will provide for the utilization of a plurality of implements, with means whereby to normally house such implements, provide for their independent utilization, and normally prevent loss thereof.

Machines and Mechanical Devices

TALKING MACHINE.—L. S. HOLMBOE, Oklahoma, Okla. An object of this invention is to provide a mechanism automatically operated, at the conclusion of the reproduction of a record, to raise the sound box or reproducer from engagement with the record and return the same, together with the tone arm, to its original starting position, whereupon the sound box is again lowered and the stylus caused to engage the record groove. The invention has for another object to provide mechanism for automatically reproducing several records successively without the necessity of removing and replacing a record after the completion of its reproduction.

COTTON LINT CONDENSER AND FLUE.—C. W. WICKER, 1185 Agnes Place, Memphis, Tenn. In this invention the important features reside in a short flue arranged to cause any heavier particles to separate and escape from the flue while the lint passes to the main flue; and



AN ENLARGED SECTION OF THE APPARATUS

revolving condenser having a screen cylinder to which the lint adheres under suction produced within the cylinder. The screen with the adhering lint passes between pairs of inner and outer rollers to an area relieved of suction which permits the lint to drop. The condenser and appurtenances are so arranged that the air produced by the suction fan may be discharged to do useful work instead of exhausting to the atmosphere.

Pertaining to Recreation

AMUSEMENT DEVICE.—J. IRSCH, 308 E. 50th St., New York, N. Y. The invention has for its object to provide an amusement device with a number of workable members for various players arranged to operate at different speeds according to the action of the player, these various members being under the control of a single person so that when one player has reached his goal the various devices may be locked against operation and thereby indicate the winner of the game and also the second and third places.

Pertaining to Vehicles

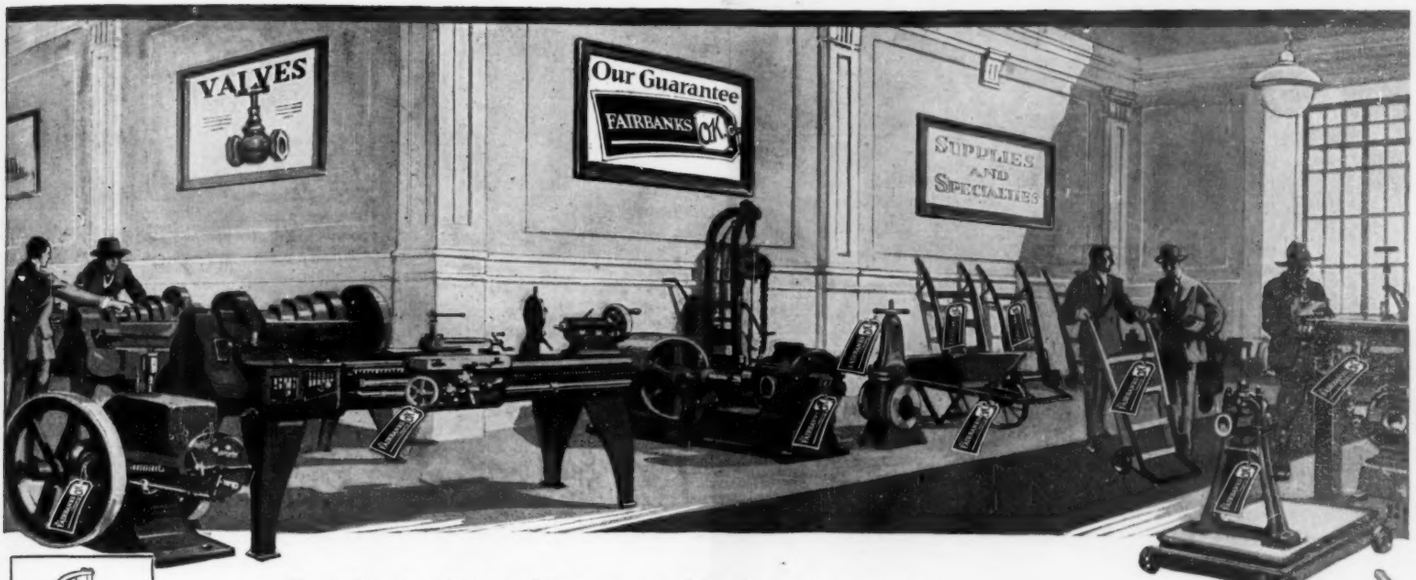
AUTOMOBILE SEAT.—H. G. LATIMER, Jr., 104 North St., Auburn, N. Y. The general object of the invention is to provide an automobile driver's seat in which the back cushion is adjustable forward or back independently of the seat. More especially the object is to provide the adjustable back cushion with rigid supporting means having floor support and means to effect an interlocking engagement between the seat and the supporting means of the back cushion in any given adjustment of the back.

GEAR WHEEL.—H. W. WRIGHT and J. M. RATCLIFF, 1542 E. 22d St., Los Angeles, Cal. The object of this invention is to provide a device of the character specified wherein the rim is sectioned and detachably connected to the spokes, which are cast or otherwise formed with the hub thus eliminating a considerable expense and labor in the formation of the wheel.

Designs

DESIGN FOR DOLLS CRADLE.—F. BARANELLO, 143 Hudson Ave., Brooklyn, N. Y.

DESIGN FOR A LIQUID SOAP FIXTURE.—M. H. JACOBS, 295 Pearl St., New York, N. Y.



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Chaining the Missouri

(*Continued from page 306*)

top and to the trees on the other end. These trees were ordinary cottonwoods, sawed off at the bottom; they averaged twelve inches in diameter at the foot.

The other photographs show what happened. A very considerable bar was formed in twenty-one days by this obstruction. This bar was photographed again after it had gone through the winter, and high water and ice from the spring freshets had buffeted it, and, if anything it had grown larger.

In one place where the new method was used, the bank was receding so fast that twenty acres had gone into the river during the thirty days immediately before the piles were put in position. Not a foot of ground has been lost since then. The immediate effect of these retards is so to slow the current as it passes through them that it simply unloads its cargo of solid matter and forms a bar. Ice cannot damage the obstructions because they are placed below its reach, and high water merely acts to build the bar higher.

Professor O. V. P. Stout, Dean of the College of Engineering of the University of Nebraska, has been active in the experimental work with the new pile, and is enthusiastic in his commendation of it. It may be of interest to quote his brief statement of the theory involved, and the results attained under his immediate observation. He says:

"The pile, with steel cable attached, is sunk completely into the river bed, at a depth designed to be beyond the reach of the scouring action of the current, so that the pile serves as a 'dead man' to anchor a construction which is bound to it by means of cable. This construction may be of a variety of sorts. In work completed up to the present time it consists of trees, or of trees and logs, so placed as to form a construction suggestive of either a raft or boom, with cables interwoven, or a permeable dike—being really neither one nor the other, but of a nature between the two. The effect, however, is very similar to that of the permeable dike, and the considerations which govern the location of the new substitute are largely the same. In this way, it has been found possible quickly to build up bars. The earlier constructions have survived floods and the breaking up of ice, and the piles and this system have been adopted by the Chicago, Burlington and Quincy R. R. with pronounced success in resisting the encroachments of the Missouri River at different points. Owners of threatened land on the banks of the river are also arranging to use these piles and the constructions mentioned or are selling their immediately menaced properties to those who will safeguard the purchases in this way—the original possessors getting their main compensation through the advanced value which this added security gives their remaining acres."

The Desert Sign Post

(*Continued from page 307*)

driest, the hottest, and the least explored tract of the desert realm, and also because of the strategic importance of obtaining information about the possible water supplies along a stretch of 350 miles of the national frontier adjacent to Mexico.

As a result of these activities, signs directing travelers to water were erected at 167 localities in California and at 138 in Arizona. According to Director George Otis Smith of the U. S. Geological Survey, "On the basis of the work already done it is estimated that the rest of the region of 570,000 square miles can be covered after the manner of this year's work for $100,000, which is only about $8 per township." And as this authority says, the benefits are bound to be very large, indeed, in comparison with the outlay.

The signposts that now serve as heartening guides to water along the arid highways, over which the volume of traffic is steadily increasing, stand 12 feet high and are painted white so that they may be seen from afar. The uprights are of galvanized iron 1.9 inches in outside diameter, and the signboards, of 18-gage steel, galvanized, have their lettering marked upon them in dark blue. These boards are of two sizes, 18 x 20 inches and 9 x 20 inches, depending upon whether they bear directions to two or four watering places. Each post is anchored in the ground by means of two redwood blocks. The task so far completed is merely a part of a comprehensive plan which calls for the mapping and marking of the watering places in the entire arid region lying east of the Sierra Nevada and Cascade Mountains and west of a line running approximately from eastern Oregon through Salt Lake City and Santa Fe down to the mouth of the Pecos River.

As exploratory work has established beyond question, the desert territory contains rich deposits of zinc, borax, niter, and other mineral wealth, and it is prophesied that from these lands we shall eventually extract great quantities of potash. While existing vegetation is sparse and for the most part made up of plant life that can endure upon a minimum of moisture, still the soil is identical with that which has proved so fertile in Arizona when stimulated by irrigation. A conspicuous characteristic of all of the streams that flow into any part of this desert realm is the bigness of their sources and the smallness of their terminals—one cannot say mouths—where they are lost in the avid earth.

It is this peculiarity, this disappearance of surface water, that indicates the existence of a far-reaching subterranean flow which breaks to the light of day again here and there at the little springs and pools that dot the desert at widely separated points. Further, ditches dug in some of the old river beds, as was practiced on the Nile thousands of years ago, have furnished enough moisture to raise garden truck for some of the isolated mining camps. With this knowledge, it is authoritatively stated that the driving of artesian wells will probably tap water in sufficient volume and of a kind which would make possible the growing of great crops of foodstuffs. Not only does this promise to introduce agriculture where now a veritable waste holds sway, but the advent of a plenty of water will make it feasible to exploit the mineral riches which Nature has stored there.

Finally, these wonderful, widespread arid lands may become the seats of invigorating health, places where the utterly tired, the nerve-wrecked, may obtain that calm and repose so needful to restoration. The atmosphere out in that desert section is marvelously pure and bracing, especially in the higher altitudes or after sundown, and the silence of night is impressively profound. As Mr. Parsons expresses it: "It would seem as though no ill that flesh is heir to could exist under its benign influence."

Manifestly, now that we are spending so willingly millions of dollars for one public purpose or another, the granting of $100,000 or so for the completion of the desert survey, the planting of signposts, the drilling of wells, the installation of modest pumping equipment where necessary, and the preparation of maps, should not cause Congress a moment's hesitation. There are economic possibilities involved of incalculable moment, and science, engineering, and industry are concerned—not to mention the public weal in other ways.

The Lesson of the Caldwell Range

(*Continued from page 310*)

rection of a trained and competent instructor, and the purpose of every stu-

dent marksman was to acquire that proficiency which should make it possible for him to see to it that well nigh every bullet found a billet should he face the enemy on the battlefield. Because of the painstaking system employed there was not a single participant injured during the firing of more than 40,000,000 rounds of ammunition on the several ranges—more rounds, so it is said, "than the navy has ever fired in times of peace and war in all of its previous history." Men that never before had held a loaded rifle in their hands qualified as marksmen in an astonishingly short while, so skilfully were they taught and coached.

The point to be driven home upon the nation now is the need of keeping up this schooling and of fostering in every possible way a countrywide interest in rifle shooting. Whether this be primarily a sporting movement or not, the ultimate gain will be the strengthening of our military preparedness against the always possible questioning of our rights by some hostile power. Further, a nation of marksmen is far less likely to invite attack or to be menaced by threats of war than one less qualified to take care of itself and to make its bullets score. In the days long gone, our people shot well because the gun was a continual provider of food or a safeguard against the treachery of the Indians; and it was this skill that turned the tide in our favor during the years of the Revolution.

But, as has been said by one of the closest students of the art of the rifleman, proficiency is not a birthright but the product of painstaking efforts plus self-control, in which the mind, the nerves, and the muscles are wonderfully coördinated. The consequence is a moral strengthening, greater capacity to meet promptly a difficult situation, and the power of thinking quickly. In short, the trained rifleman is apt to be a better and a more valuable citizen all because of his schooling on the range.

It is the purpose of the National Rifle Association of America to revive the widest possible interest in marksmanship among all of our citizenry. To this end, the intention is to keep active, if possible, every one of the ranges established during the last two and a half years. Similarly, the association is anxious to see used to their utmost the other ranges existing throughout the various States. The master range, the one located near Caldwell, New Jersey, should be the keystone of this whole system; and this can only be done by making the Government's tenure of that wonderfully located tract a permanent one.

Our ordnance engineers and American inventors have given us weapons of high power, long range, and notable accuracy. But these material gifts would be of comparatively little avail as instruments of defense if they were not placed in the hands of those able, through practice, to handle them effectively. As Theodore Roosevelt said: "Only the shots that hit, count."

The General Utility Sewer

(*Continued from page 311*)

of the street. There would then be no more flooding of sidewalks by clogged sewer openings, and there would be no possibility of the flow attaining such proportions, during heavy precipitation, that it could not all enter the sewer. We have all seen the water from a thunder storm surging back and forth in the gutters around the corner drains, making huge lakes which block pedestrian traffic; with the far greater exit area offered by the narrower but continuous opening in the middle of the street this could not happen.

The slot opening into the sewer would be covered, as the drawing indicates, by iron covers similar in general style to the present manhole covers. Instead of being round, of course they would be rectangular; but their size would be such

as to make for convenient handling. They would have a normal position flush with the pavement surface, leaving passage under their edges for the rain water—various designs will occur to the reader by means of which such passage could be provided for. Then they would have a secondary and more elevated position, to which they would have to be raised for the purposes of snow removal. When so raised, the snow could be scraped or swept down from the curb lines to the middle of the street and into the sewer slot. There would be no congestion in the street around isolated openings, and there would be no congestion in the sewer, since the snow would arrive in equal quantities in all parts of the trench.

The next fundamental feature of Mr. Davidson's design is the segregation of the sanitary flow. This, as the sketch makes clear, would be in a separate gallery, below the one into which the snow would fall. In this way there could be no mingling of the snow with the normal fluid contents of the sewer; there could be no offensive odors to rise through the opening; and above all, there could be no flooding of the street with sewage in the event that any accident should lead to overflow of rain water from the sewer. All storm waste is in the upper gallery, entirely distinct from the water that carries offensive matter with it; and again there would be advantage from this separation when it became necessary to clean out the storm gallery.

So far as its actual service as a sewer is concerned, Mr. Davidson's project is completely described by this; but he goes further, and effects an economy and convenience which would be of tremendous import in the long run. Residents of any city of size must know how often streets are torn up for the prosecution of repairs or replacements or new installations in the province of the gas man or the water company or the lighting or telephone systems. It seems sometimes that the agents of these several utilities are engaged in a constant race to see which can dig the most and the deepest holes, and cover them over least effectively. If we let Mr. Davidson build our sewers for us, he will change all this; he will put all pipe lines and conduits of every description in a large gallery adjoining his sewer, built at the same time, and fundamentally a part of the same installation. Then any necessary work on these lines can be done quietly and quickly, without disturbing the street surface.

In New York the smallest sewer installed is now a 2-foot-4-inch x 3-foot-6-inch egg-shaped affair. In its place is recommended a 3-foot sewer of the type illustrated; but the flow capacity of the latter is equal to that of a 5-foot-3-inch sewer of the old style. Under the circumstances its cost should be compared with a larger sewer than the minimum; and when this is done, we find a disparity of barely five dollars a linear foot, as far as costs can be accurately estimated. From this should be deducted the saving in snow removal and the value of the new sewer's greater convenience.

That this convenience is very real can be realized by considering the circumstances of a typical New York snowfall. For this purpose the snowfall of December 15, 1916, is selected, since it was unaffected by previous or subsequent storms. This storm was to all intents and purposes equivalent to a uniform fall of four inches throughout the city. Removal stretched over a period of ten days, and natural shrinkage was such that on the last day of this period only a third of the original fall remained for removal. Had this fall been removed within a reasonable time, a good deal more snow would have been available for removal, with a consequently heavier cost. This state of affairs is typical; because of the slowness of current methods of snow disposal, we remove only a fraction of the precipitation, the elements disposing of the greater part; and then we have a certain amount of snow and ice to handle which would have been taken away by an efficient system, while it was still snow. Mr. Davidson claims that under his system all the work of snow removal would be done by the regular staff of the Street Cleaning Department in the regular course of business, and that this system is competent to clean the entire area affected within twenty-four hours after the termination of a blizzard.

Our Technical Achievements in the Great War

(*Continued from page 312*)

the alinement, and one does not proceed very far with a study of these fascinating data before he realizes that to the question "Who Won the War," only God himself could give the correct answer. For if the question seriously came up for discussion, you would get many different answers, all of them, probably, as divergent as the people to whom the question was put. A Frenchman, for instance, would remind you that the ultimate test of the work done in winning the war is the total number of men killed in action, or subsequently dying of wounds received in battle, and he would point to the fact that France, with a total list of dead of 1,385,000 men, has done the hardest, the longest and the most decisive fighting of the war, since, of all her major allies the British lost less than a million men, the Italians less than half a million and the United States less than 50,000 men. He would tell you that when the war burst forth, France was the only country which possessed a large modern army and a highly trained staff that conformed to the accepted standards of the best military authorities; he would remind you that it was because this heroic army had bared its breast to the onslaught and stood unflinching throughout the whole four and a half years of the war, that the Allies have been able to achieve a final victory.

The Britisher would tell you that history has shown over and over again the importance, in a far-flung war like this, of the command of the sea. He would tell you that it was his fleet which held the enemy helpless in their own ports. He would tell you that world-wide transportation was an absolute essential to the defeat of Germany; that it was because his fleet and his great merchant marine cleared the seas and carried the men, the munitions and the food, that victory was made possible. He would tell you that his army of 6,500,000 men fought on seventeen different fronts, and lost 900,000 dead, and that he loaned $8,000,000,000 to his allies to carry on their operations. It was this far-flung effort, he would say, that won the war.

A subject of Italy would tell you that, if she had listened to the call of the Triple Alliance, of which she was a member, and had moved to the eastern frontiers of France, the French would have had to divert three quarters of a million men from the German front to meet the peril. He would point to the fact that Italy disowned her former allies, and crippled the strength of the Austrian effort by holding a vast Austrian army amid the snows and rocky defiles of the northern and eastern Italian frontiers. Thus, he would say, did Italy turn the balance in favor of the Allies, make secure the eastern flank of their armies in France, and finally make possible the overthrow of the Central Powers.

And so if you should chance to ask the question of some citizen of the United States, he might say that while it is true we lost only 49,000 dead to France's 1,385,000 dead, our list of dead was small because, compared to our Allies, we were in the fighting only for a limited time, and that we came in with two million men in France, two million more

(*Continued on page 326*)

Our Technical Achievements in the Great War

(Continued from page 324)

getting ready in America and ten million back of those, if we needed them; and that it was the moral effect, due to the realization of the excellent fighting quality of the armies under General Pershing, and the defeat of the Germans at St. Mihiel and the Argonne that led the enemy to throw down their arms. He would point also to the fact that our expenditures of twenty-two billion dollars was not far below that of France, and he would remind you that no small part of the stiffening of the Allied morale was due to the coming of our troops, coupled with the wonderful work done by the Red Cross and similar organizations, to say nothing of our carrying on the work, hitherto done by Great Britain, of financing the war for all the Allies.

And so the endless and fruitless comparisons and discussions might go on eternally, with no other result, as we have said, than to break down the excellent feeling of brotherhood which had been born of the war and the substituting in its stead of jealousy, heart burnings and distrust.

Now that the enemy has been crushed in the conflict, it is for the Allied nations to consolidate the fruits of the war and place themselves in such a relation to each other, throughout the world at large, that never again shall there be a resort to the bloody arbitrament of war.

Steam and Internal Combustion Engines

(Continued from page 313)

owing to the high temperature of the water surrounding the combustion cylinder, the gases are actually heated rather than being cooled during compression. The cooling of the cylinder is controlled at a uniform temperature throughout, and it is obtained by converting the water into steam without raising its temperature.

The following is a summary of the advantages claimed for the Still engine:

The mean temperature of the cylinder walls is higher than in ordinary engines, the cooler parts being maintained at a higher temperature, and the hotter parts at a lower temperature. The piston is cooler owing to the expansion of steam behind it. The high efficiency of the combustion cycle is augmented, because the walls are at a higher and more constant temperature, and this is proportionate to the rise in temperature of the jacket water. Frictional losses are reduced by the higher temperature and because the steam overcomes the inertia of the reciprocating masses at the lower dead center. The mechanical efficiency is higher than that obtainable in a normal engine of similar type. The steam expanding as it does in a cylinder hotter than itself, gives an indicator diagram larger than that theoretically obtainable under ideal conditions in an ordinary steam engine. Twenty-nine per cent of additional brake horse-power is added to the shaft of the engine without increase in the fuel consumed (steam not condensed). Forty per cent is added with the condenser used, the air pump being separately driven. The indicated horse-power due to steam appears as brake horse-power added to the shaft, all of the mechanical losses having already been accounted for in measuring the combustion brake horse-power.

Mr. Acland's paper on the Still engine will be found in the current SCIENTIFIC AMERICAN SUPPLEMENT.

Asbestos Mines of Quebec

(Continued from page 315)

in diameter. The ultimate fiber might conceivably be just one molecule in diameter. Mica has been split to a thickness equal to one-half wave-length of violet light, closely approaching this limit.

Open-pit mining or glory-hole work is

used throughout the Quebec district, the mines running sometimes to a depth of 300 feet. Underground work is carried on at some of the mines during the winter months and searchlights have been employed to render night working possible. Some of the mines separate the barren rock from the asbestos-bearing portion in the pit and each is loaded into separate boxes. In most however the hand separation commences after the rock reaches the surface by means of the aerial cableways shown in the illustrations, or by other means.

After the hand separation the barren rock goes to the rock pile and the rock which will afford crude asbestos is taken to the cobbing sheds where it is separated by hand and the asbestos bagged. The remainder usually 35 per cent to 70 per cent of all rock handled and which contains asbestos requiring mechanical separation, goes to ore bins or in some cases directly to the mill for concentration. For the first fifteen years after the opening up of the asbestos mines cobbing was the only means of recovering asbestos but in 1893 the process of mechanical concentration now used, with but slight modifications, was devised.

Practically all the mills use the same system for the separation of the asbestos and considerable ingenuity is displayed in its carrying out. The milling practice consists essentially of coarse crushing, drying and alternate fiber crushing and screening. At each screening the asbestos then liberated is drawn off through overhead pipes by suction bands and collected in settling tanks. When thoroughly screened from dust and classified according to length of fiber by rotary screens the different grades pass to their respective storage bins or are bagged for the market.

Jaw crushers are used in the coarser crushings while for the finer crushing gyratories or rolls are employed. Rolls have the disadvantage of requiring a special machine for teasing out the fiber after it has passed through them. The final crushing is effected in a machine called a cyclone and built especially for the purpose. This consists of two beaters or fans of chilled iron in shape like the screw propeller of a boat and weighing about 100 lbs. These beaters revolve in a closed chamber at a speed of 2,000 revolutions per minute or more, and drive the rock fragments together, thus releasing the smallest particles of asbestos, which are then collected.

Unique Wall-Board Machine

(Continued from page 317)

side of the machine and is similar to the drive on a paper machine.

In the foreground of the photograph may be noted the cutter, which operates by means of a revolving knife in a top roll acting against a hard wood strip in a bottom roll, the material passing between them. Pull rolls between slitters and cutting-off roll keep the board under tension at all times. The speed of the cutting knife, whether cutting long or short lengths, can be arranged to assume the speed of the board at the instant of cutting. This is accomplished by means of elliptic gears, the one on the roll being adjustable in its relation to the knife. —*F. C. Perkins.*

Sells Fresh Fruit Juice

ONE of the most interesting of the soft drink industries which have been launched the present season is the manufacture and sale of fresh orange juice, cull oranges being used. The plan as conceived by the by-products organization of the California Fruit Growers' Exchange has unique features, and suggests considerable future development in this direction.

For some time the fruit exchange through an auxiliary has been manufacturing cull oranges into marmalade. Pos-

sibilities in the city soft drink trade interested the management, which believed cull oranges so used might return a good profit and incidentally widen the market for the grade. It was decided to make Los Angeles a test city, and there a factory was established equipped with special machinery for extracting juice. To help place the new product before the public, the company opened a store, attractively located, where for a nickel the thirsty can obtain a large glass of ice-cold pure orange juice.

The reader should not confuse pure fresh orange juice with various orange drinks long on the market. When the fruit exchange people decided to manufacture fresh orange juice, there was no place in Los Angeles where the drink was sold. To manufacture and sell the product a highly efficient organization is required.

The cull oranges to be processed are shipped to the Los Angeles factory in stated quantities, being diverted daily from the marmalade factory at San Dimas. The work of extraction begins at 2 A. M. The juice is chilled and placed in stone jars, and at 4 A. M. the delivery force starts to work. The trucks deliver to restaurants, hotels, soda fountains, clubs, etc. The guarantee given is that the juice is pure, fresh, and in condition to keep well for 24 hours. The initial price at wholesale is reasonable—75 cents a gallon.

Extension of this plan to other cities is being considered. Such cities would be within a territory where freight charges on the cull oranges would not be too high. The orange industry naturally regards the innovation of real importance, as profitable disposal of cull grades is a decided help in the industry.—*J. T. Bartlett.*

What Are Naval Stores?

New Methods of Production Development in an Old Industry

PITCH and tar were the chief products of the naval stores industry up to the middle of the eighteenth century. The name "Naval Stores" was applied to them on account of their extensive use in the construction and maintenance of sailing vessels. The term is now applied to the turpentine and rosin industry, which products have beome more important than pitch and tar in commerce.

The Office of Public Record, London, in a manuscript dated 1610 published some quaint "Instructions for such things as are to be sent from Virginia." Conservation of forest resources is not wholly a modern idea for the "Instructions" have this to say about the products of the "Pyne Trees."

"Pyne trees, or ffire trees are to be wounded within a yarde of the grounde, or boare a hoal with an agar the thirde pte into the tree, and lett yt runne into anye thinge that may receyue the same, and that wch yssues owte wil be Turpentyne worth 18 d. Tonne. When the tree beginneth to runne softelye yt is to be stopped up agayne for preserveinge the tree."

All of which contains the germ of the principle of forest conservation—if one can only grasp it through the mess of involved grammatical construction and bad spelling.

Restricted Growth of a Valuable Industry

The rosin and turpentine industry has had its ups and downs. One drawback to a healthy growth of its commercial value has been the lack of improved and economical methods in production. Until recent years no special pains had been taken to prolong the life of the trees which yield the gum. The methods in vogue in this country before the War of the Revolution were largely used until recently. The wasteful box method of tapping and the old-fashioned deep chipping are only lately being gradually replaced by the cup system and the light chipping method which are less harmful to the tree and give a greater yield. Experiments along these lines have been made in recent years under the direction of the United States Forest Service. The Forest Products Laboratory at Madison, Wis., is continuing these experiments and related studies in many forest products.

In spite of the lack of satisfactory production methods naval stores have been so widely used in many different commercial products that the output has grown to large proportions. During the five years from 1910 to 1915 this country produced in round numbers 31,800,000 gallons of turpentine and 3,700,000 barrels of rosin. Over half of these products are exported as the United States practically supplies the world with rosin and turpentine. The prices of naval stores have fluctuated but have nevertheless, displayed a steadily rising tendency.

The value of naval stores produced in the United States in 1850 was $2,856,000. In 1910 the value was $35,935,000. The reason for this relatively large increase of output is clear when we consider some of the various uses to which rosin and turpentine are now put.

Some Uses of Naval Stores

The most important use of turpentine is in paints and varnishes. It is used also in preventing the running of colors in print goods of wool or cotton. It has the property of preventing the color from penetrating the fabric. Turpentine is important as a solvent for rubber Caoutchouc and similar substances. It has also medicinal uses.

Rosin has the property of combining with alkalies such as caustic soda and potash to form soaps which are readily soluble in water. Rosin is also used as a drier or oxidizer in oil paints and varnishes. The enamels used on earthenware consist of metallic resinates. During the war large quantities of rosin were used in shrapnel shell.

When destructively distilled rosin furnishes a light and a heavy oil. The lighter oil is used as a solvent. The heavier rosin oil proper is treated with milk of lime producing a lubricating grease.

One of the most important uses of rosin is as a "size" or finish coating for writing and printing papers which must take ink. To produce the finish rosin soap is added to the wood pulp from which the paper is made. An alum solution is also added. When the pulp is rolled into sheets and dried the rosin gives a smooth varnish-like finish to the surface.

Results of Investigation

It is estimated that an increased yield valued at $5,000,000 annually is possible by the use of the Forest Service cup and gutter method of tapping pine trees. To keep up the present output of naval stores about 5,000,000 acres must be tapped each year. The lumbering industry in the Southeast cuts down about 1,000,000 acres of pine trees annually. The result is that longleaf pine for turpentining has become scarce in the Carolinas and Georgia. In Alabama, Mississippi, Louisiana, and Texas the timber is held by lumber syndicates which are usually unwilling to permit turpentining.

The shortage of suitable timber for naval stores production led the Forest Service during 1911 and 1912 to consider the western pines as a source of supply. While in general the yield of western pines was not found to be as great as that of the southeastern trees, it is probable that the former will have to be worked sooner or later in order to secure the required quantities of rosin and turpentine.

Waste wood has been shown to have some possibilities as a source of naval stores. Pine stumps have been shredded and extracted for turpentine and rosin. Using small chips, over 90 per cent of the rosin was removed. It was found that the residual chips had value as pulpwood for the manufacture of wrapping paper.

The Balanced Ration on the Poultry Farm

WE hear a great deal about balanced rations as regards the human diet; but the subject is of no less importance to the grower of live stock. What the farmer makes in the field he can easily lose in the barn and the feed lot. He must feed his stock, not necessarily with what figures out as the scientifically perfect combination, but with the combination under which he can make the most money. This means that he must give equal weight to the market value of each ingredient, and to its effect upon the animal mechanism.

The principle involved stands forth with extraordinary clearness in a discussion which has been going on in Connecticut poultry-raising circles. The hen is fed with the view of making her egg production a maximum. Now in manufacturing an egg, the hen must take the raw materials which she gets in her food and convert them into one white and one yolk and one shell. It is the white and the yolk which enter into the argument, since the shell largely regulates itself.

Suppose that biddy gets an unbalanced ration, consuming in a week food capable of making three whites and six yolks; how many eggs will she lay? It doesn't take a mathematician to answer, "Three." With a properly balanced ration, assuming that oyster shells are available for the hen so that she can attend to this feature for herself, an equal number of whites and yolks will be manufactured, and the waste involved by an excess of yolk-forming elements in the ration will be avoided.

Of course, in the poultry yard as elsewhere it may not be good business to use an ideal balanced ration. If we can use a near-balanced ration that costs 20 per cent less while reducing egg production only 10 per cent, we are going to employ this substitute in place of the theoretical ideal. Maximum production attained with entire disregard of cost is no more possible in the egg factory than in the foundry or the machine shop. Nevertheless, making due allowance for this factor, and for the fact that the average hen is more or less of a scavenger, general farmers do commit glaring errors in feeding hens; and intelligent study of food values would save them millions of dollars annually.

Right here is where Connecticut's contribution comes in. A table of feed values has been compiled, not as formerly in terms of carbohydrates and proteins and other things that need to be translated to the farmer, but in terms of egg-whites and egg-yolks attainable from 100 pounds of each feed in question. Some of the leading items from this table are here reproduced.

Food	Per 100 Lbs. Yolks	Whites
Kaffir corn	254	125
Corn	255	134
Wheat	243	182
Buckwheat	178	128
Cow peas	189	305
Sunflower seed	233	266
Alfalfa meal	230	430
Cottonseed meal	148	620
Middlings	205	212
Ground oats	195	155
Barley	203	145
Meat scraps	106	1,107
Fish scraps	87	806
Fresh-cut bone	196	336
Skim milk	22	52
Buttermilk	22	65
Alfalfa	46	67
Clover	54	48
Corn fodder	42	16
Cabbage	40	16
Potatoes	55	15
Corn silage	42	15
Apples	62	12

To make a balanced ration, the farmer, remembering that variety stimulates appetite and that the ration should be neither too concentrated nor too bulky, mixes available feeds in such proportions that an equal number of yolks and whites will be produced. With the table at hand, he can choose intelligently between various feeds, with local market prices as a basis. A sample ration might be something like this:

	Lbs.	Yolks	Whites
Whole corn	200	510	268
Mash—middlings	20	41	44
bran	20	31	41
oats	20	39	31
cornmeal	20	52	28
Meat scraps	26	27	288
	306	700	700

In addition to these items, the careful farmer would also feed some green stuff, valuable not so much for yolk-and-white value as for stimulative and digestive effect. Then, whenever the state of his market made it desirable to shift from one or more of the ingredients named, he would refer to his table and work out a new combination of proper balance and reasonable cost. For the presence of such extremes in the direction of white production as the meat and fish scraps always makes it possible to employ such yolk-producing ingredients as are to be had most cheaply, and then to strike a balance with the proper amount of highly abluminous matter.

Perhaps the greatest single point to be derived from the above table has to do with excessive corn-feeding. Corn is an excellent fattener; but when fed almost to the exclusion of anything else, it becomes extravagant, because of the great surplus over what the hen can use for maintenance and egg-manufacture must go to the making of fat. Corn is so universally grown on American farms that it is often used in this uneconomical fashion. The result obtained, especially in winter when the hen is fed mainly for maintenance rather than for egg production, could be accomplished with much less expense.

The Current Supplement

SOME of the results of chemical investigations for practical ends, imposed on Germany by the exigencies of decreased supply during war-time conditions, are now appearing in journals brought to this country and in publishing these it is believed that the SCIENTIFIC AMERICAN SUPPLEMENT is rendering a real and tangible service to American industries. At any rate the article *Benzinoform in High-tension Oil-break Switches*, which appears in the SUPPLEMENT for September 27, 1919 (issue No. 2282) contains interesting and valuable experience which will be appreciated by many in charge of progressive electrical installations. Benzinoform alone was found to have certain disadvantages in spite of its non-combustibility, but an appropriate proportion of oil mixed with it gave a liquid of very promising character. A very well illustrated article of English origin deals with the new and very promising improvements embodied in *"The Still Engine,"* which utilizes in an economical way almost all the thermal units generated by the fuel.

To a Scottish engineer we owe a very interesting detail research on the *Stress Lines in Steel After Permanent Deformation*, carried out by means of the Shore scleroscope and based on lines of equal hardness drawn at small intervals across the stressed material. He finds "a connection between the direction of stress and the degree of hardening produced." Some very interesting photographs illustrate *Preparing Cork for Shipment*, and two rather less mechanical contributions discuss at some length *Electrical Phenomena in the Upper Atmosphere* and *Monistic versus Dualistic Conceptions of the Stellar Universe*. The latter article which is a product of the very latest reflections on its subject stands as an excellent companion to the most interesting account of the life work and views of *Copernicus* who founded heliocentric astronomy.

Other shorter topics of interest touch upon *Boring in Trinidad Asphalt Lake, Diffraction of Electric Waves by the Earth, Origin of Spectra, Power from Tidal Waters.*

Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters in patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(14312) M. O. P. asks: to settle an argument will you please tell me if the air pressure is heavier or lighter at a higher altitude. One said the higher you go the lighter the air and the other said the higher you go the heavier the air. Which is correct? A. The air pressure is less at a higher altitude than at a lower altitude. When the barometer stands at 30 inches at sea level, the pressure is 15 pounds on each square inch. At that time the barometer will stand at 29 inches at places 910 feet above sea level and at 28 inches at places about 1,800 feet above sea level. If a pressure of 15 pounds per square inch can hold up 30 inches of mercury in a vacuum, 28 inches of mercury will mean a pressure of 14 pounds and 29 inches will imply a pressure of 14½ pounds. At an altitude of 3.6 miles the barometer will register 15 inches, which means that half the air is below 3.6 miles above sea level.

(14313) W. D. McK. asks: I have for many years been very much interested in the construction of an Aeolian Harp. I am enclosing a self-addressed envelope asking you to kindly give such a description as would enable an ordinary carpenter to successfully construct one of these boxes. A. The Aeolian Harp consists of a box whose ends are of hard wood, oak, hard pine, or maple, as may be convenient, and the bottom, sides and top are of pine, although the top should be made of spruce or fir. Such as is used for the belly of violins if it can be had. The ends should be thick enough to be bored with holes for the tuning pins. The bottom and sides may be a half inch thick but the top should be thin like the belly of a violin, for it is the top which resounds to strengthen the sound of the strings. Eight to twelve catgut strings of different thicknesses may be used. They are set like the strings of a violin and stretched over hard wood bridges one bridge at each end of the box. By the sides of the bridges should be cut holes similar to those in the belly of a violin, to increase the vibration of the top of the box. All the strings are tuned to exact unison, but left rather slack, since the friction of the wind could not vibrate a string drawn tight. The length of the box is that of the width of the window into which it is to be put, three feet or so. It may be five or six inches wide and three inches deep. It should be so placed that the wind draws obliquely across the strings. This is the harp as usually made. An improvement has been applied to it by making a box to increase the velocity of the wind. A board is placed from one to three inches above the strings, and extended outwards, with other boards to form a spreading funnel which will concentrate the breeze and increase its velocity as it flows over the strings. This attachment may be fastened to the ends and bottom of the box of the harp, but must not touch the top or sounding board. Any ingenious carpenter can adjust this attachment.

(14314) J. W. asks: Will you please do me a favor? I can't convince a friend of mine that it is impossible to so construct a vacuum pump that he can crush a container by vacuum able to withstand a pressure both internally and externally of 17 pounds. When an air tight vessel is subjected to vacuum there can be no greater stress on container than 16 pounds regardless of style of pump now in existence or likely to be. Please make a statement so I can convince him. A. The pressure of the atmosphere is 14.7 pounds on one square inch when the barometer stands at 39.7 inches. With the barometer at 31 inches the pressure is 16.3 pounds. The air cannot produce a greater pressure at these barometers than we have given, and any container which can carry these pressures cannot be broken if there is a vacuum inside the container. The incandescent lamp bulb is a good example of a very thin walled vessel sustaining the pressure of the air on the outside while there is a very high vacuum on the inside. You are quite right in your position.

(14315) W. H. B. asks: I have been making some investigation recently in regard to the history of the day-line, and I would consider it a very personal favor if you would send to me by mail any information you have concerning this question. I am especially interested in the following phases of the subject: 1. The original location of the day line. 2. How often has it been moved? 3. Has its being moved ever affected the calendar on any of the continents? If not, why not? A. The International Day Line does not cross any continent, excepting a small portion of Siberia near the Behring's Sea, and so cannot affect the calendar of any civilized country. It does not follow 180th meridian, but deviates to the east and west to include islands belonging to the same country and thus prevent a change of day among the same people. In theory it follows the 180th meridian, and in the open sea it coincides with this meridian. It turns to the west to take in several of the Hawaiian Islands which belong to the United States and further south it bends again. You can get the history of the day line from the Hydrographic Office, Washington, D. C.

NEW BOOKS, ETC.

THE DRAMATIC STORY OF OLD GLORY. By Samuel Abbott. Foreword by James M. Beck. New York: Boni and Liveright. 12mo.

Do we owe our beloved flag to Benjamin Franklin? Mr. Abbott contends that we do. With a well-charged, colorful brush, he depicts stirring incidents that center about the stars and stripes: many of these dramatic pictures have not before appeared in any book, and the way in which they are dealt with enables us to relive the glories of our historial past. While it necessarily follows a beaten track, the work reveals new beauties along the roadside, and renews our enthusiasm for the mighty deeds that have kept Old Glory floating in the van of the world's progress.

AVIATION. Theorico-Practical Text-Book for Students. By Benjamin M. Carmina. New York: The Macmillan Company, 1919. 8vo.; 172 pp.; illustrated.

Every rounded concept of science is bipolar, with theory as its negative and practice as its positive terminus. To neglect theory is to lose the best fruits of practice; to plunge into theory at the expense of practice is equally nullifying. This text so combines the two that the student who follows it will acquire the fundamentals minus the confusion. The fight of an airplane is analyzed and clarified, construction is thoroughly explained, all parts are described and illustrated, and there are hints on flight and on maintenance. An appendix contains formulas and calculations, and there is a glossary and a full index.

A SAMPLE CASE OF HUMOR. By Strickland Gillilan. Chicago: Forbes and Company, 1919. 8vo.; 113 pp.

This "sample case" dispenses various kinds of humor with some attempt at classification. There are stories of the humorless person who makes for mirth in others, of boomerang humor that recoils upon the head of him who launches it, of the humor brought into our lives by the child, the foreigner, and even the animals. Gillilan's mind is always clean and kindly, and he who samples the stories here told is sure to ask for more.

METAL WORKER'S HANDY-BOOK OF RECEIPTS AND PROCESSES. Edited by William T. Brannt. New York: Henry Carey Baird and Co., 1919. 8vo.; 582 pp.

Artificers have long relied upon this manual as a sterling collection of practical formulas and methods for the handling of metals and alloys, drawn from native and foreign sources by an able editor. Chemical relations, metallic preparations, and amalgams are dealt with at considerable length; every kind of process from annealing, hardening and tempering, casting and founding, to the niceties of the decorative and preservative arts, is described, with a wealth of successful recipes. This latest edition carries a great deal of new material on flame welding and cutting, thermit welding, electric welding, galvanizing, Schoop's spray process, sherardizing, and die castings. Admirable selective judgment and absolute reliability are the outstanding features of the work.

ON UNCLE SAM'S WATER WAGON. By Helen Watkeys Moore. New York, G. P. Putnam's Sons, 1919. 8vo.; 222 pp.

This is an assortment of five hundred recipes for non-alcoholic drinks. It gives the most approved ways of preparing tea, coffee, and other standard beverages, and follows with those concocted from milk, eggs, and fruits, and with ginger ale, invalid drinks, syrups and sundaes. As the author says, the acceptance of the Eighteenth Amendment "does not mean that men and women will no longer become thirsty," and it is reasonable to suppose that the manufacture of drinks in the home will receive a strong impetus. The book provides the knowledge necessary to make, at home, a profusion of appetizing and wholesome thirst-quenchers.

ABRASIVES AND ABRASIVE WHEELS. Their Nature, Manufacture and Use. By Fred B. Jacobs. New York: The Norman W. Henley Publishing Co., 1919. 8vo.; 338 pp.; illustrated.

The grindstone, prototype of modern abrasive wheels, was used by the armorer in 1570; emery was used by the ancient Greeks. Our precision grinding of today, fathered by the paper-making industry and flowering to perfection under the demands of the sewing-machine and automobile, is an indispensable art, used in every line of metal-working. Mr. Jacobs gives us a most interesting and valuable work dealing with the manufacture and practical use of abrasives and abrasive wheels and with grinding operations; with truing, rebushing and installing wheels, safety devices, and dust collecting systems, followed by an exposition of surface, external and internal grinding.

LOCATION OF STARTING AND LIGHTING SYSTEM TROUBLES MADE EASY. By Victor W. Pagé, M. E. New York: The Norman W. Henley Publishing Co. 24x38 in.

Here is another chart by the master of automobile chart-making, the attractive and helpful qualties of which are apparent at a glance. It requires more than a glance, however, to appreciate the ingenuity with which a small bookful of information has been compressed into a single sheet without omitting anything of value. The illustrations show all parts of starting, lighting and ignition systems. With the aid of the printed instructions, faults in wiring or in any of the several units of these systems may readily be located and remedied. Motorists and repairmen may use the chart to great advantage.

SIMPLE RULES AND PROBLEMS IN NAVIGATION. By Charles H. Cugle. Corrected and revised by Bradley Jones. New York: E. P. Dutton and Company, 1919. 8vo.; 305 pp.; diagrams.

Nothing is taken for granted in this third edition of a work of high merit by a master mariner. The problems, worked out in full to a fine degree of accuracy, have been scrutinized by several competent navigators; added features include the international rule of the road at sea, a method of preparing a station bill for boat and fire drill, and new methods of finding latitude and longitude. The work embraces the whole subject of navigation, and all in the plainest language.

SELECTED ARTICLES ON EMPLOYMENT MANAGEMENT. Compiled and edited by Daniel Bloomfield. Introduction by Meyer Bloomfield. New York: The H. W. Wilson Company, 1919.

Employment management is a comparatively new subject to the industrial executive. These papers by many authorities represent the best available material on the problems of labor maintenance, the employment manager and his department, placement, promotion and conclusion of employment, the figuring of the labor turnover, and many other important phases of the subject. A good bibliography, and an appendix containing examples of typical forms used in the well-organized department, round out a compilation that will be welcomed by students as of the highest practical value. The Handbook Series is the distinct gainer by this accession.

NAVIGATION AND NAUTICAL ASTRONOMY. By Prof. J. H. C. Coffin. Revised and enlarged by Elmer B. Collins, Navy Department. New York: D. Van Nostrand Company, 1919. 8vo.; 259 pp.; illustrated.

This standard work was originally prepared for the use of the United States Naval Academy. In its present revised and enlarged form it takes into account the modern, improved methods of solving navigational problems, and also the change in the arrangement of the current Nautical Almanac; considerations of this nature have led to the elimination of all superseded material and obsolete examples, to a revision of the chapter on the Summer line, and to a new chapter dealing with all cases met with in the New Navigation.

THE U. S. GEOLOGICAL SURVEY. Its History, Activities and Organization. New York and London: D. Appleton and Company, 1918. 8vo.; 163 pp.; 2 folding maps.

With a view to the improvement of Government service, an association of citizens known as The Institute for Government Research is putting out a series of monographs on the various branches of activity. This, No. 1 of the series, gives a history of the establishment and growth of the Survey, details its accomplishment, describes organization and equipment, and gives laws and regulations, financial statements, and a full bibliography. The usefulness and interest of such orderly, accessible information is apparent. It should find grateful acceptance among executive officials, members of Congress, and the reading public.

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